1.0 INTRODUCTION

This report presents the Feasibility Study (FS) for the Portland Harbor Superfund Site in Portland, Oregon (Figure 1-1). Portland Harbor was evaluated and proposed for inclusion on the National Priorities List (NPL) pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund), 42 U.S.C. §9605, by the U.S. Environmental Protection Agency (EPA) and formally listed as a Superfund Site in December 2000. The lead agency for this site is EPA.

The basis of this FS is environmental data collected and compiled by the Lower Willamette Group (LWG) and other ~~sources~~parties since the inception of the Portland Harbor Remedial Investigation and Feasibility Study (RI/FS) in 2001[1]. The LWG is performing the remedial investigation (RI) and FS for the Portland Harbor Superfund Site (Site) pursuant to an EPA Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study (AOC; EPA 2001, 2003, 2006). Oversight of LWG's Portland Harbor RI and FS is being provided by EPA with support from Oregon Department of Environmental Quality (DEQ).

The RI (insert citation) has been completed and has characterized the Site sufficiently to define the nature and extent of the source material and the Site-related contaminants~~, as the site existed in the early 2000s~~. Baseline ecological and human health risk assessments (Windward 2013; Kennedy Jenks 2013) have also been completed. The site characterization and baseline risk assessments are sufficient to complete the FS for the Site.[2]

This FS focuses on approximately ten miles of the lower Willamette River from RM 1.9 (at the upriver end of the Port of Portland's Terminal 5) to RM 11.8 (near the Broadway Bridge), sometimes referred to as the "site" in this FS for convenience. The terms site, harbor-wide, and site-wide used in this FS generally refer to the sediments, pore water, and surface water within this reach of the lower Willamette River, not to the upland portions ~~(above elevation 13.3 feet North American Vertical Datum of 1988 [NAVD88])~~ of the Portland Harbor Superfund Site.

This FS is consistent with CERCLA, as amended (42 United States Code [U.S.C.] 9601 et seq.), and its regulations, the National Oil and Hazardous Substances Pollution

Commented [KK1]: Accept edit.

Commented [KK2]: Reject change. Extraneous and may not be accurate since data collection efforts ranged from the late 1990's to late 2000's. Sampling in the RI went up to 2009. This edit makes it seem that the data were collected at the beginning of 2000 (2001-2002).

Commented [A3]: This statement is difficult for the reader to verify without a clear CSM being presented in FS Section 1. See the major issue comment below where CSM is mentioned in the text.

Commented [KK4R3]: This information is provided in the RI Report, which is cited at the intro to this paragraph. The sentence in question is irrelevant to the CSM. The question is whether the site is sufficiently characterized for the FS to proceed.

Commented [KK5]: Accept footnote.

Commented [KK6]: Accept edit.

Commented [KK7]: Reject edit. While the study area had this boundary, the FS is including river banks to the top of bank.

[1] Upland source control efforts, including site-specific upland source control studies and implementation of source control measures, are performed under the oversight of the Oregon Department of Environmental Quality and are not within the scope of the Agreement and Order on Consent and Statement of Work for the in-water portion of the Site.

[2] Although this section identifies many specific sources of contamination, neither this section nor this report generally is intended as an exhaustive list of current or historical sources of contamination.

Contingency Plan (40 Code of Federal Regulations [CFR] Part 300), commonly referred to as the National Contingency Plan (NCP) and was prepared in accordance with EPA guidance. Guidance documents used in preparing this FS include:

- *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988)
- *Clarification of the Role of Applicable or Relevant and Appropriate Requirements in Establishing Preliminary Remediation Goals under CERCLA* (EPA 1997a)
- *Rules of Thumb for Superfund Remedy Selection* (EPA 1997b)
- *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (EPA 2002)
- *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA 2005)
- *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000).
- *Technical Resource Document on Monitored Natural Recovery* (EPA 2014)

Commented [A8]: Although this reference was used, this seems a bit specific for the introduction.

Commented [KK9R8]: Reject edit. This should be a list of EPA Guidance used to develop this FS. It seems appropriate to list the cost estimation guidance here. .I've also added another guidance document that was recently published.

1.1 PURPOSE AND ORGANIZATION OF REPORT

The purpose of the FS is to identify, develop, screen, and evaluate a range of remedial alternatives to reduce risks ~~for~~from ~~the~~ contaminated media to acceptable levels and to provide the regulatory agencies with sufficient information to select a remedy that meets the requirements established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This FS report is comprised of four sections as described below.

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- Section 1 – Introduction:~~,~~ P~~p~~rovides a summary of the Site RI, including Site description, Site history, nature and extent of contamination, contaminant fate and transport, and baseline human health and ecological risks.

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- Section 2 - Identification and Screening of Technologies:~~, d~~ Develops remedial action objectives (RAOs), develops preliminary remediation goals (PRGs) for addressing human health and ecological risks posed by contaminants in sediment and tissue, develops general response actions (GRAs) for each medium of interest, identifies areas of media to which general response actions might be

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applied, identifies and screens remedial technologies and process options, and identifies and evaluates technology process options to select a representative process for each technology type retained for consideration.

- Section 3 - Development and Screening of Alternatives: P~~p~~resents a range of remedial alternatives developed by combining the feasible technologies and process options. The alternatives are then refined and screened to reduce the number of alternatives that will be analyzed in detail. This screening aids in streamlining the feasibility study process while ensuring that the most promising alternatives are being considered.

- Section 4 - Detailed Analysis of Alternatives: P~~p~~rovides the detailed analysis of each alternative with respect to the following seven criteria: 1) overall protection of human health and the environment, 2) compliance with ARARs, 3) long-term effectiveness and permanence, 4) reduction of toxicity, mobility, or volume through treatment, 5) short-term effectiveness, 6) implementability, and 7) cost. In addition to the detailed analysis, a comparative analysis of remedial action alternatives is also presented in this section. EPA also recognizes that this site affects many stakeholders, including communities with environmental justice ~~communities~~ concerns who live along the river or who live elsewhere but use the river. ~~, and t~~The evaluation of remedial alternatives ~~will~~ considers impacts to these communities.

1.2 BACKGROUND INFORMATION

1.2.1 Site Description

The Willamette River originates within Oregon in the Cascade Mountain Range and flows approximately 187 miles north to its confluence with the Columbia River, and is one of 14 American Heritage Rivers in the country. It is the 12th largest river in the United States, and drains 11.7 percent of the State of Oregon. As Oregon's major port and population center, the lower Willamette River sees a great variety of uses including ~~ranging from~~ shipping, industrial, fishing, recreational, natural resource, and other uses. The lower reach of the Willamette River from River Mile (RM) 0 to approximately RM 26.5 is a wide, shallow, slow moving segment that is tidally influenced with tidal reversals occurring during low flow periods as far upstream as RM 15. The river segment between RM 3 and RM 10 is the primary depositional area of the lower Willamette River system. The lower reach has been extensively dredged to maintain a 40-foot deep navigation channel from RM 0 to RM 11.~~6~~7.

~~The Portland Harbor RI/FS "Study Area" was defined by EPA as Lower Willamette River mile (RM) 1.9 to 11.8 extending up to a vertical elevation of 13.3 feet NAVD88, and is~~

Commented [KK13]: Accept edit.

Commented [KK14]: Accept edit.

Commented [A15]: What is the basis for identifying EJ communities? As currently understood, EPA has not designated any community along Portland Harbor as EJ.

Commented [KK16R15]: Reject edit. EPA does not designate areas with EJ concerns. EJ communities include minority, low-income, tribal and other vulnerable communities, which are all known to reside within the vicinity of Portland Harbor. Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Fair treatment means that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies.

Meaningful Involvement means that:
- people have an opportunity to participate in decisions about activities that may affect their environment and/or health;
- the public's contribution can influence the regulatory agency's decision;
- their concerns will be considered in the decision making process; and
- the decision makers seek out and facilitate the involvement of those potentially affected

Commented [KK17]: Accept edit.

Commented [KK18]: Accept edit.

Commented [KK19]: Reject edit.

Commented [KK20]: Reject edit.

Commented [KK21]: Accept edit.

Commented [KK22]: EPA did not define the "Study Area". For us, the Study Area encompasses all area studied, which would be RM 0.2 to RM 26.5. The LWG has maintained some defined boundary of this area and the construct has been from the LWG, not from EPA. Some of the suggested text by LWG was incorporated as second sentence.

~~located~~ The Portland Harbor RI/FS Study Area is located along ~~an~~ the lLower rReach of theis ~~11.6-mile dredged reach of the~~ ~~L~~lower Willamette River in Portland, Oregon known as Portland Harbor (**Figure 1-1** ~~and **Figures 1.11-2a through 1.11-2d**~~). The RI/FS Study Area extends from river mile (RM) 1.9 to 11.8 and up to a vertical elevation of 13.3 feet NAVD88. ~~The Portland Harbor RI/FS Study Area is located along an 11.6-mile dredged reach of the Lower Willamette River in Portland, Oregon known as Portland Harbor (**Figure 1-1** and **Figures 1.11-2a through 1.11-2d**).~~ While the harbor area is extensively industrialized, it occurs within a region characterized by commercial, residential, recreational, and agricultural uses. Land use along the lower Willamette River in the harbor includes marine terminals, manufacturing, and other commercial operations, as well as public facilities, parks, and open spaces. **Figures 1.2-1a** through **1.2-1d** illustrate land use zoning within the lower Willamette River as well as waterfront land ownership. The State of Oregon owns certain submerged and submersible lands underlying navigable and tidally influenced waters. The ownership of submerged and submersible lands is complicated and has changed over time (**Figure 1.2-2**).

Today, the Willamette River is noticeably different from the river prior to industrial development that commenced in the mid to late 18th century. The main river now has been redirected and channelized, several lakes and wetlands in the lower floodplain have been filled and agricultural lands converted to urban or industrial areas. The end result is a river that is deeper and narrower than it was historically with higher banks that prevent the river from expanding during high-flow events. The Willamette River channel, from the Broadway Bridge (RM 11.6) to the mouth (RM 0), currently varies in width from 600 to 1,900 feet. Further, the installation of a series of dams moderate fluctuations of flow in the lower Willamette River.

Little, if any, original shoreline or river bottom exists that has not been modified by the above actions, or as a result of them. Much of the shoreline has been raised, filled, stabilized, and/or engineered and contains overwater piers and berths, port terminals and slips, stormwater and industrial wastewater outfalls and combined sewer overflows (CSOs), and other engineered features. Constructed structures, such as wharfs, piers, floating docks, and pilings, are especially common in Portland Harbor where urbanization and industrialization are most prevalent. These structures are built largely to accommodate or support shipping traffic within the river and to stabilize the riverbanks for urban development. Constructed structures are clearly visible in the aerial photos provided in **Figures 1.2-3a** through **1.2-3n**

Armoring to stabilize banks covers approximately half of the harbor shoreline, which is integral to the operation of activities that characterize Portland Harbor. Riprap is the most common bank-stabilization measure. However, upland bulkheads and rubble piles are also used to stabilize the banks. Seawalls are used to control periodic flooding as

Commented [A23]: Unclear what figures are being referred to. These numbers are not in the EPA figures list.

Commented [KK24R23]: I assume that these are figures depicting four reaches of the river. Agree to delete.

Commented [KK25]: Since I added in the recommended language from the LWG, it is redundant with this sentence, so it has been deleted.

Commented [KK26]: Accept edit.

Commented [A27]: Suggest also including Figure 2.4.2 from the Draft FS here.

Commented [KK28R27]: Accept including figure, but need to delete AOPC delineations and only show cap at McCormick and Baxter – other caps are only temporary.

Commented [A29]: We question that the addition of 15 pages of aerial photos from the RI "streamlines" the FS. For example, draft FS Figure 2.4-3 shows site uses and structures in four pages and conveys other more relevant information for the FS as well.

Commented [KK30R29]: It is not a matter of "streamlining" the FS, but providing the information necessary to illustrate the discussion. I didn't find the reference figures useful in delineating the structures at the site since they are difficult to see. I did find these helpful in illustrating the navigation area and FMD areas and included it above.

most of the original wetlands bordering the Willamette in the Portland Harbor area have been filled. Some riverbank areas and adjacent parcels have been abandoned and allowed to revegetate, and beaches have formed along some modified shorelines due to relatively natural processes.

A federal navigation channel, maintained to a depth of -40 feet with an authorized depth of -43 feet, extends from the confluence of the lower Willamette River with the Columbia River to RM 11.7 (**Figure 1.2-4**). The lower Willamette River federal navigation project was first authorized in 1878 to deepen and maintain parts of the Columbia River and lower Willamette River with a 20-foot minimum depth. The depth of the navigation channel has been deepened at various intervals since that time (i.e., increased to 25 feet in 1899, 30 feet in 1912, 35 feet in 1930, and 40 feet in 1962). Container and other commercial vessels regularly transit the river. Certain parts of the river require periodic maintenance dredging to keep the navigation channel at its maintained depth. In addition, the Port of Portland and other private entities periodically perform maintenance dredging to support access to dock and wharf facilities. Dredging activity has greatly altered the physical and ecological environment of the river in Portland Harbor.

Development of the river has resulted in major modifications to the ecological function of the lower Willamette River. However, a number of species of invertebrates, fishes, birds, amphibians, and mammals, including some protected by the Endangered Species Act (ESA), use habitats that occur within and along the river. The river is also an important rearing site and pathway for migration of anadromous fishes, such as salmon and lamprey. Various recreational fisheries, including salmon, bass, sturgeon, crayfish, and others, are active within the lower Willamette River. A detailed description of ecological communities in Portland Harbor is presented in the Baseline Ecological Risk Assessment (BERA) provided as Appendix G of the RI Report.

Commented [A31]: Regardless of any other document that may state this, the edit shown is the factually correct current situation at the site.

Commented [KK32R31]: Agree with edits.

Commented [KK33]: Add Figure 2.4-3 with noted modifications here.

Commented [KK34]: Agree with edit.

Commented [A35]: This text should be moved to Section 1.2.1. This is not "site history".

Commented [KK36R35]: Agree with edit.

Commented [A37]: Same comment. This is not "site history" and should be moved to Section 1.2.1

Commented [KK38R37]: Agree with edit.

1.2.2 Site History

Since the late 1800s, the Portland Harbor section of the Lower Willamette River has been extensively modified to accommodate a vigorous shipping industry. Modifications include redirection and channelization of the main river, draining seasonal and permanent wetlands in the lower floodplain, and relatively frequent dredging to maintain the navigation channel. ~~Constructed structures, such as wharfs, piers, floating docks, and pilings, are especially common in Portland Harbor where urbanization and industrialization are most prevalent. These structures are built largely to accommodate or support shipping traffic within the river and to stabilize the riverbanks for urban development. Riprap is the most common bank-stabilization measure. However, upland bulkheads and rubble piles are also used to stabilize the banks. Seawalls are used to control periodic flooding as most of the original wetlands~~

~~bordering the Willamette in the Portland Harbor area have been filled.~~ ~~Constructed structures are clearly visible in the aerial photos provided in **Figures 1.2-2a** through **1.2-2n**~~.

~~Today, the Willamette River is noticeably different from the river prior to industrial development that commenced in the mid to late 18th century.~~ Historically, the Willamette was wider, had more sand bars and shoals, and fluctuated greatly in volume. ~~In contrast, the main river now has been redirected and channelized, several lakes and wetlands in the lower floodplain have been filled and agricultural lands converted to urban or industrial areas. The end result is a river that is deeper and narrower than it was historically with higher banks that prevent the river from expanding during high-flow events. The Willamette River channel, from the Broadway Bridge (RM 11.6) to the mouth (RM 0), currently varies in width from 600 to 1,900 feet. Further, the installation of a series of dams moderate fluctuations of flow in the lower Willamette River. Little, if any, original shoreline or river bottom exists that has not been modified by the above actions, or as a result of them. Riprap is the most common bank-stabilization measure. However, upland bulkheads and rubble piles are also used to stabilize the banks. Seawalls are used to control periodic flooding as most of the original wetlands bordering the Willamette in the Portland Harbor area have been filled Some riverbank areas and adjacent parcels have been abandoned and allowed to revegetate, and beaches have formed along some modified shorelines due to relatively natural processes.~~

~~A federal navigation channel, maintained to a depth of -40 feet with an authorized depth of -430 feet, extends from the confluence of the lower Willamette River with the Columbia River to RM 11.76. The lower Willamette River federal navigation project was first authorized in 1878 to deepen and maintain parts of the Columbia River and lower Willamette River with a 20-foot minimum depth. The depth of the navigation channel has been deepened at various intervals since that time (i.e., increased to 25 feet in 1899, 30 feet in 1912, 35 feet in 1930, and 40 feet in 1962). Container and other commercial vessels regularly transit the river. Certain parts of the river require periodic maintenance dredging to keep the navigation channel at its maintained authorized depth. In addition, the Port of Portland and other private entities periodically perform maintenance dredging to support access to dock and wharf facilities. Dredging activity has greatly altered the physical and ecological environment of the river in Portland Harbor.~~

~~Development of the river has resulted in major modifications to the ecological function of the lower Willamette River. However, a number of species of invertebrates, fishes, birds, amphibians, and mammals, including some protected by the Endangered Species Act (ESA), use habitats that occur within and along the river. The river is also an important rearing site and pathway for migration of anadromous fishes, such as salmon~~

Commented [A39]: Although much of this text is from the 2014 RI draft, the portion about seawalls controlling flooding appears misleading. Also, the Draft FS text captured this better. "Much of the shoreline has been raised, filled, stabilized, and/or engineered and contains overwater piers and berths, port terminals and slips, stormwater and industrial wastewater outfalls and combined sewer overflows (CSOs), and other engineered features. Armoring covers approximately half of the harbor shoreline, which is integral to the operation of activities that characterize Portland Harbor"

Commented [KK40R39]: Why is sentence on seawalls misleading? They were primarily installed to protect the uplands from flood events. It seems as if two concepts were being discussed that confused the discussion. The discussion of structures and seawalls is separated and moved to site description.

Commented [A41]: Also, this text should be moved to Section 1.2.1, because it refers to current conditions, while this section is titled "Site History".

Commented [KK42R41]: History is a relative term. The intent of this section is to describe how the site has come to be how it currently exists.

Commented [A43]: We question that the addition of 15 pages of aerial photos from the RI "streamlines" the FS. For example, draft FS Figure 2.4-3 shows site uses and structures in four pages and conveys other more relevant information for the FS as well.

Commented [A44]: Regardless of any other document that may state this, the edit shown is the factually correct current situation at the site.

Commented [KK45R44]: OK

Commented [KK46]: Edit is OK.

Commented [A47]: This text should be moved to Section 1.2.1. This is not "site history".

Commented [KK48R47]: Text will remain – see response above.

Commented [KK49]: Add Figure 2.4-3 with modifications here.

~~and lamprey. Various recreational fisheries, including salmon, bass, sturgeon, crayfish, and others, are active within the lower Willamette River. A detailed description of ecological communities in Portland Harbor is presented in the Baseline Ecological Risk Assessment (BERA) provided as Appendix G of the RI Report.~~

The lower Willamette River and its adjacent upland areas have been used for industrial, commercial, and shipping operations for over a century. Commercial and industrial development in Portland Harbor accelerated in the 1920s and again during World War II, which reinvigorated industry following the Great Depression. Before World War II, industrial development primarily included sawmills, manufactured gas production (MGP), bulk fuel terminals, and smaller industrial facilities. During World War II, a considerable number of ships were built at military shipyards located in Portland Harbor. Additional industrial operations located along the river in the post-World War II years included wood-treatment, agricultural chemical production, battery processing, ship loading and unloading, ship maintenance, repair and dismantling, chemical manufacturing and distribution, metal recycling, steel mills, smelters, ~~and~~ foundries, electrical production, marine shipping and associated operations, rail yards, and ~~and~~ rail car manufacturing. Many of these operations continue today. Contaminants associated with these operations were released from various sources and migrated to the lower Willamette River. The long history of industrial and shipping activities in the Portland Harbor, as well as agricultural, industrial, and municipal activities upstream of Portland Harbor, has contributed to chemical contamination of surface water and sediments in the ~~L~~lower Willamette River. ~~Detailed information regarding historic and current sources of contamination in the lower Willamette River is provided in Section 4 of the RI Report.~~

~~Historical and current locations of various industrial facilities identified along the lower Willamette River are provided by industrial sector in **Figures 1.2-3a** through **1.2-3j**. The approximate location of facilities is shown on the maps; however, the actual extent of historical and current facilities/operations is not shown.~~

~~Each of these industrial sectors has been is typically associated with the use of various chemicals. The contaminants most commonly associated with each industry sector include the following:~~

~~**Industrial Sector**~~	~~**Common Industry Contaminants**~~
~~Ship Building, Dismantling, and Repair~~	~~Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), total~~

Commented [A50]: Same comment. This is not "site history" and should be moved to Section 1.2.1

Commented [KK51R50]: Text will remain – see response above.

Commented [KK52]: Accept edit.

Commented [KK53]: Accept edit.

Commented [KK54]: The following information was removed and moved below to new section 1.2.3.1 Sources.

Commented [A55]: Appendix Q has more detailed information regarding current site sources. It should be cited here and generally used in the FS.

Commented [KK56R55]: Appendix Q is not being used in the revised FS.

Commented [KK57]: Reject edit.

Commented [A58]: Revisions to RI Section 4 and the FS regarding sources need to be made consistent.

Commented [A59]: Again, we question that the addition of a many page figure from the RI streamlines the FS. We suggest that instead EPA cite the RI and not reproduce these figures here. Also, Figure 2.4-1 from the draft FS shows site ownership, which is similar.

Commented [KK60R59]: It is not a matter of "streamlining" the FS, but providing the information necessary to illustrate the discussion. Since the following issue discussed is contaminants associated with industrial sectors, not sources, so the reader needs to know where they are located. I didn't find the reference figures useful.

Commented [KK61]: Reject edit.

Commented [A62]: In instances where the RI is still being finalized, information needs to be made consistent between RI and FS. For example: Section 3.2.3 of 2014 RI discusses how the contaminants actually vary and are "dependent upon the activities conducted".

Commented [A63]: The lists of contaminants here should be made consistent with the RLSO contaminant additions in the 2014 RI. There are multiple inconsistencies. Also, the additional language from the RI such as "can be associated with" and "dependent on the activities conducted" should be copied here.

Commented [KK64R63]: Agreed.

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~~**Industrial Sector**~~	~~**Common Industry Contaminants**~~
	~~petroleum hydrocarbons (TPH), metals, phthalates, butyltins~~
~~Wood Products and Wood Treating~~	~~VOCs, SVOCs, TPH (oil, grease, diesel, gasoline), benzene, PAHs, metals, wood preservatives (arsenic compounds, copper compounds, chromium compounds, pesticides, fungicides, biocides, borates, pentachlorophenol, creosote, acid/alkaline wastes, PCBs, dioxins/furans~~
~~Chemical Manufacturing and Distribution~~	~~Vary depending on the operations, but chemical manufacturing known to have occurred within Portland Harbor, includes pesticides, herbicides, VOCs, SVOCs, dioxins/furans, metals, PCBs, solvents, acid/alkaline wastes, benzene, TPH (oil, grease, diesel, gasoline), and PAHs~~
~~Metal Recycling, Production, and Fabrication~~	~~VOCs, SVOCs, TPH, PCBs, metals, infectious/bacterial contamination, asbestos, cyanide, phthalates, fuel additives, and products of incomplete combustion, battery acid~~
~~Manufactured Gas Production~~	~~VOCs including benzene, toluene, ethylbenzene, and xylenes (BTEX), SVOCs, PAHs, TPH, metals, and cyanide~~
~~Electrical Production and Distribution~~	~~PCBs, TPH, and PAHs~~
~~Bulk Fuel Distribution and Storage, and Asphalt Manufacturing~~	~~VOCs (benzene), SVOCs, PAHs, TPH (oil, gas and diesel fuels), metals, gasoline additives (methyl tert-butyl ether [MTBE], ethylene dibromide [EDB], ethylene dichloride [EDC])~~
~~Steel Mills, Smelters, and Foundries~~	~~Metals, TPH (from oil, gas, and diesel fuels), PAHs, PCBs, fuel additives, chlorinated solvents (VOCs)~~

Commented [A63]: The lists of contaminants here should be made consistent with the RLSO contaminant additions in the 2014 RI. There are multiple inconsistencies. Also, the additional language from the RI such as "can be associated with" and "dependent on the activities conducted" should be copied here.

Commented [KK64R63]: Agreed.

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Commented [A65]: 2014 RI lists out specific metals including Cu, Cr, Zn, Pb, Hg

Commented [KK66R65]: Agreed.

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Commented [KK67]: Disagree with strikeout. It is consistent with Revisions to Section 3 of RI.

Commented [A68]: There are several RLSO contaminant additions in the 2014 RI that should be made consistent here.

Commented [KK69R68]: Agreed. The "Author" did not provide what changes should be made to be consistent, so EPA made changes it felt were appropriate to this list of contaminants.

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Commented [CS70]: What is this supported by?

Commented [KK71R70]: As cited in the RI, references EPA 2006g,h,i,j.

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Commented [A72]: The 2014 RIA text provides a citation for MGP contaminants.

Commented [KK73R72]: Noted.

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~~**Industrial Sector**~~	~~**Common Industry Contaminants**~~
~~Commodities Maritime Shipping and Associated Marine Operations~~	~~Spillage of raw materials during transport to and from vessels, butyltins, metals, TPH (gasoline, diesel, oil, lubricants and grease), fuel additives, chlorinated solvents (VOCs)~~
~~Rail Yards~~	~~VOCs, SVOCs, TPH, PCBs, and metals~~

~~Contaminants released during industry operations and/or other activities to the air, soil, groundwater, surface water, and/or impervious surfaces can potentially migrate to the lower Willamette River via the following pathways: direct discharge, overland transport, groundwater, riverbank erosion, atmospheric deposition, overwater activities, and upstream watershed.~~

~~One key migration pathway for contaminants from these various industries to migrate to the river was through direct discharge via numerous publicmunicipal and private outfalls, including storm drains and combined sewer overflows, which were and some still are located along both shores of the lower Willamette River in the metropolitan area. In the early 1900s, rivers in the United States were generally used as open sewers, which was also true for the Willamette (Carter 2006). The growing city's untreated sewage, as well as process water from a variety of industries, including slaughterhouses, chemical plants, electroplaters, paper mills, and food processors, was discharged directly into the river. The City of Portland constructed a wastewater treatment plant in the early 1950s and regulatory actions in the 1960s and 1970s, such as the Clean Water Act, gradually reduced the direct discharge of waste to the Willamette River.~~

~~Historical releases from upland or overwater activities within the Study Area likely contributed to the majority of the observed contaminant distribution in sediments within the Study Area. The majority of current contaminant pathways to the river (soil erosion, groundwater, and stormwater) from upland sources are a result of historical operational practices, spills, and other releases.~~

~~In addition, point and nonpoint discharges within the Willamette River Basin are potential sources of contamination in sediment, surface water, and biota in the Study Area. Contaminants in discharges and runoff from diverse land uses in the basin eventually enter the river upstream of the Study Area. Contaminant loading from sediment transport and water from upstream areas throughout the last century may also contributed to the conditions currently observed in the Study Area.~~

Commented [A63]: The lists of contaminants here should be made consistent with the RLSO contaminant additions in the 2014 RI. There are multiple inconsistencies. Also, the additional language from the RI such as "can be associated with" and "dependent on the activities conducted" should be copied here.

Commented [KK64R63]: Agreed.

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Commented [CS74]: This is another example of text that needs to be made consistent with the RI, in this case Section 3.2.3.1. EPA agreed there to include wording that the contaminants are "dependent upon the activities conducted but could include PCBs, oil and grease, lubricants, paint pigments or additives, transmission and brake fluids, fuel, battery acid, lead, antifreeze, chemical residue, petroleum products, solvents, asbestos, phthalates, and heavy metals (EPA 2006m, footnote 20)".[emphasis added].

Commented [KK75R74]: Emphasized language included in intro to this table.

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Commented [KK76]: Edit is OK.

Commented [A77]: This phrase was struck from the 2014 RI Section 4.3.1.

Commented [KK78R77]: Agreed. This also needs to be stricken from RI Section 1.

Commented [A79]: Needs reference. This statement is not from the 2014 RI based on review of the 2014 RI Section 4.3. The 2014 RI discusses "municipal conveyance systems included interceptors and associated facilities" installed in the 50s.

Commented [KK80R79]: Modified to be consistent with RI Section 4.

Commented [CS81]: We assume this is what was meant.

Commented [KK82R81]: Agreed.

Commented [A83]: This is not site history and could be moved to Section 1.2.1 or to a discussion of sources.

Commented [KK84R83]: Disagree. This is historical as well as current.

Commented [A85]: There is no real doubt about this.

Commented [KK86R85]: OK.

~~1.2.2.2~~1.2.2.1 Investigation History

Many environmental investigations by private, state, and federal agencies have been conducted, both in the lower Willamette River and on adjacent upland properties, to characterize the nature and extent of contamination in the river, as well as to identify potential sources of contaminants that could continue to enter the river. Investigations have been conducted in Portland Harbor from the 1920s to the present, with most studies being performed from the late 1970s through the present ~~the 1990s~~. Nearly 700 documents and data sets were obtained that address conditions in the lower Willamette River. Specific historical and recent studies and data sets were selected for inclusion in the data set used to characterize and evaluate the Study Area in the RI and FS reports. ~~Section 2 of the RI discusses and identifies the specific non-LWG collected data that were included in the RI data set.~~

Site data were collected by the LWG during four major rounds of field investigations between 2001 and 2008 to complete the RI. ~~Additional studies completed by other entities after this time were included in the FS dataset (see Section 1.3).~~ The investigations were often timed around varying river stages, river flows, and storm events. The field investigations first began in 2001 in the Initial Study Area (ISA) as defined by the AOC, SOW, and Programmatic Work Plan as RM 3 to RM 9. As the studies commenced, the Study Area was expanded ~~to include~~ from RM 1.9 to RM 11.8, as well as ~~and included~~ a portion of Multnomah Channel. ~~Additional studies were conducted by specific parties at several sites within the Study Area with EPA oversight includinge offshore areas of: Arkema, Gasco (NW Natural), Siltronic, Terminal 4, and River Mile 11 East. Some of Tthe data generated from these investigations were included in the RI data set and additional later data from these same sites was included in the FS data sets (see Section 1.3).~~ Studies conducted by the LWG also included areas downriver of the Study Area to the confluence with the Columbia River at RM 0 and upriver to RM 28.4. Surface and subsurface sediment samples, sediment trap samples, riverbank sediment and soil samples, surface water samples, stormwater and stormwater solids samples, groundwater samples, transition zone water (TZW) samples, and biota/tissue samples were collected and analyzed during the various investigations.

~~1.2.2.4~~1.2.2.2 Upland Source Control Measures

Identifying current sources of contamination to the Study Area and eliminating or minimizing these pathways where possible is critical for remedy effectiveness as well as evaluating the recontamination potential of a cleanup. In February 2001, DEQ, EPA, and other governmental parties signed a Memorandum of Understanding (MOU) agreeing that DEQ, using state cleanup authority, has lead technical and legal responsibility for identifying and controlling upland sources of contamination that may impact the river (e.g., sediment, groundwater, transition zone water, and/or surface water). Currently, DEQ is investigating or directing source control work at over 90

Commented [KK87]: Reject edit.

Commented [A88]: Although this is consistent with the RI, it seems clear that as many or more studies were conducted after this time.

Commented [KK89R88]: Absent the data studies collected by the LWG, it does not appear that many studies have really taken place more recently that were used in the RI or FS. The only studies that have really been conducted since the 1990s has been for the listing of PH. This is supposed to be a history of investigations, not current investigations.

Commented [KK90]: Accept edit.

Commented [KK91]: Reject edit.

Commented [A92]: The FS database needs to be referred to for the FS, given it differs from the RI database AND will differ even more with EPA's proposed inclusion of more early action data. See proposed addition of Section 1.3 on the FS database.

Commented [KK93R92]: This is a summary of the RI and should discuss the RI information. New Section 1.3 will discuss the FS database and how it differs from the RI database. EPA agrees that the last sentence is unnecessary.

Commented [KK94]: Reject edit. This added statement makes the paragraph inaccurate. More data than that collected by the LWG is in the RI data set, including data collected after 2008. The added language implies that only LWG data was used in the RI and additional information was added to the FS, which is not correct.

Commented [KK95]: Reject edit.

Commented [KK96]: Accept edit.

Commented [A97]: Other sites are not attributed to owners. This should be consistent one way or the other.

Commented [KK98R97]: Accept edit. It was not intended to attribute to owners but was included since the site is commonly referenced using both names.

Commented [A99]: This statement is unclear. Some of the data from the noted sites were included in the RI database and other data only included in the draft FS database. EPA is proposing to add additional data from Gasco and Arkema that are also not in the RI database.

Commented [KK100R99]: This whole statement is deleted since it is discussed later in Section 1.2.2.3.

Commented [CS101]: Per LWG's 7/23/14 major issues summary, EPA removed the summary of the source control inventory and status information and any reference to the detailed inventory in Appendix Q that EPA directed the LWG to include in the Draft FS. This is critical information for context of the Revised FS that was prepared consistent with the most recent Oregon Department of Environmental Quality (DEQ) Milestone Report for Upland Source Control available at the time. ...

Commented [KK102R101]: The information provided by the LWG is outdated. DEQ is working on a comprehensive summary of the status of source control. They are doing this in lieu of any furt ...

upland sites in Portland Harbor and evaluating investigation and remediation information at more than 80 other upland sites in the vicinity (ODEQ 2103a). Additionally, DEQ is working with the City of Portland under an Intergovernmental Agreement to identify and control upland sources draining to the Study Area through 39 city outfalls, and with the Oregon Department of Transportation on controlling sources in highway and bridge runoff drained to the Study Area (City of Portland 2012).

In 1994, the City prepared a CSO Management Plan with recommendations to address wet weather overflow discharges, including implementation of storage and treatment facilities along the Willamette River ("Big Pipe project") to control the CSO discharges. The primary means for increasing the storage capacity was through construction of the West Side Tunnel (completed in 2006) and the East Side Tunnel (completed in 2011).

The cleanup of known or potentially contaminated upland sites is tracked in DEQ's Environmental Cleanup Site Information (ECSI) database, which is available online at http://www.deq.state.or.us/lq/ECSI/ecsi.htm, and source control efforts are summarized in DEQ's Portland Harbor Upland Source Control Milestone and Summary Report~~s~~ (http://www.deq.state.or.us/lq/cu/nwr/PortlandHarbor/jointsource.htm).

Figures 1.2-~~6~~4a through **1.2-~~6~~4e** graphically display the status of DEQ source control evaluations as of 2014~~1~~ for various sites along the Study Area by potential release/migration pathways to the river.

~~Sources are discussed in more detail in subsections 1.2.3.3 and 1.2.3.4.~~ An important overall assumption of the FS is that upland sources in Portland Harbor will be controlled sufficient to achieve project goals ~~successfully~~ through the DEQ process. ~~Although sources are discussed in the FS, the sediment remedy is not intended to address or control upland sources. Groundwater is summarized in the subsections below because groundwater may impact decisions about sediment caps within the Site. Bank conditions are summarized because EPA may include some bank areas within the Portland Harbor Site based on future site-specific determinations.~~

~~1.2.2.5~~1.2.2.3 Early Action Sites

Within Portland Harbor, separate ~~removal~~ orders have been executed by EPA with various parties for five specific sites. These sites are:

1. Terminal 4 – conducted by the Port of Portland
2. Gasco ~~Removal Action (2005)~~Phase I – conducted by NW Natural
3. Gasco and Siltronic ~~Response Action (ongoing)~~ – conducted by NW Natural and Siltronic

~~For discussion purposes only – do not cite or quote. This draft document has been provided to EPA to facilitate EPA's comment process on the Draft FS in order for LWG to finalize the FS. The comments or changes (including redlines) on this document may not reflect LWG positions or the final resolution of the EPA comments.~~

Commented [A103]: Reference should be provided.

Commented [KK104R103]: Agreed. Added reference to latest milestone report. Once the DEQ Summary Report is final reference needs to be updated here.

Commented [A105]: Reference should be provided, particularly where specific numbers of sites or outfalls are mentioned.

Commented [KK106R105]: Agreed. Reference added.

Commented [A107]: Reference should be provided.

Commented [KK108R107]: The LWG did not provide a reference in the RI report. Since the City of Portland is part of the LWG, they can provide the reference if it is important.

Commented [A109]: This link goes to the milestone reports. It is our understanding that the "Summary" report does not exist yet, and will first be published in fall 2014.

Commented [KK110R109]: It will be published by the time this document is final so need to reference it here since it will supersede any milestone report. I think that both should be mentioned here.

Commented [A111]: Unclear why this figure would be included here, which is outdated as of 2011, when the text is updated based on a new, yet to be completed, DEQ source control document. A new up-to-date figure should be developed.

Commented [KK112R111]: Maps should be updated to reflect current status as was identified in the notes of the table provided with this text. The notes will be updated to reflect that the updated figures are to match the 2014 Summary Report rather than the Milestone Report.

Commented [CS113]: As indicated in comments in these subsections, the LWG proposes that these subsections be moved out of the nature and extent section, but for clarity, the existing subsection numbers are referred to here. Also, per other comments, the LWG believes other sources should also be addressed in a balanced fashion (e.g., storm water).

Commented [KK114R113]: Groundwater and banks are being discussed as nature and extent because they are within the bounds ...

Commented [KK115]: Sources are not discussed in the FS.

Commented [CS116]: EPA requested at the July 31, 2014 meeting that LWG suggest the language for additional context on ...

Commented [KK117R116]: Last two sentences in the paragraph are moved to discussion of nature and extent.

Commented [KK118]: Accept edit.

Commented [A119]: "Phase 1" does not refer to any historical document or order.

Commented [KK120R119]: Agree to remove Phase I. Reject addition edits since it provides inconsistent discussion of each ord ...

Commented [A121]: The Order refers to this as a response action and the Order is still in force.

Commented [KK122R121]: Reject addition edits since it provides inconsistent discussion of each order. Deleted "removal" ...

4. Arkema – conducted by Arkema

5. RM 11 E ~~(supplemental RI/FS)~~ – conducted by Glacier Northwest, Inc., Cargill, Inc., PacifiCorp, CBS Corporation, DIL Trust, and City of Portland.

These projects are currently in various stages of completion as described below. ~~Some Iinformation from some of these early action sites has been included in the Portland Harbor FS database (as detailed in Section 1.3for use in the development and detailed evaluation of alternatives.~~

- **Terminal 4** – The Port of Portland has been implementing a removal action at Terminal 4. A Phase I Abatement Measure was completed in 2008 that consisted of remediation and maintenance dredging of approximately 13,000 cubic yards of sediment. Remediation consisted of dredging 6,315 cubic yards of contaminated sediment and placing it in an off-site disposal facility, isolating contaminated sediment in the back of Slip 3 with a cap made of organoclay-sand mix, and stabilizing the bank along Wheeler Bay. ~~The post-construction sediment data collected in this area was are included in the FS database and this area iswill be evaluated in this FS to determine if further action is needed.~~

- **Gasco ~~Removal Action (2005)(NW Natural) Phase I~~** – A removal action was conducted at the Gasco site between August and October 2005. Approximately 15,300 cubic yards of a tar-like material and tar-like contaminated sediment were removed by dredging from the riverbank and nearshore area adjacent to the Gasco facility and disposed of off-site. After the removal action, an organoclay mat was placed along an upper-elevation band of the shoreline dredge cut. This mat was secured with placement of an overlying sand cap and quarry spalls. A 1 foot thick sand cap and 0.5 foot of erosion protection gravel was placed over the remainder of the removal area (0.4 acres). Approximately 0.5 foot of a "fringe cap" of sand material was placed over 2.3 acres of the area surrounding the removal area. ~~The post-construction sediment data collected in this area are included in the FS database.~~

- **Gasco ~~(NW Natural)~~ and Siltronic** – NW Natural and Siltronic are conducting site characterization and ~~preliminary~~ design evaluations for the area adjacent to their two facilities. ~~Data collected as part of this effort haves been incorporated within the harbor-wide FS database for use in developing and evaluating alternatives.~~ Under the order, NW Natural and Siltronic have agreed to perform further characterization, studies, analysis and preliminary design that will lead ultimately to a final remedy at the GASCO Sediments Site. Conducting this work will facilitate construction of the final remedy to begin expeditiously following issuance of a Record of Decision (ROD) for the Portland Harbor

Commented [KK123]: Reject addition edits since it provides inconsistent discussion of each order. Deleted "removal" in intro paragraph.

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Commented [A124]: Again, this is unclear given the current status of the FS datasets. Propose to reference the new Section 1.3 instead.

Commented [KK125R124]: Agreed. Deleted this information since it will be discussed in Section 1.3.

Commented [KK126]: Accept edit.

Commented [KK127]: Moved all discussions of data to Section 1.3.

Commented [A128]: See comments above about inconsistent reference to ownership and name of this action.

Commented [KK129R128]: See response above. Accept strike-out edit and reject addition edit.

Commented [A130]: Added for consistency with other descriptions.

Commented [KK131R130]: Moved to Section 1.3.

Commented [KK132]: Reject edit.

Commented [A133]: The Order covers through final remedial design.

Commented [KK134R133]: Accept edit.

Commented [KK135]: Accept edit.

Commented [A136]: Suggest referring to the FS database consistently.

Commented [KK137R136]: Agreed. Sentence moved to Section 1.3.

Commented [KK138]: Modified language to be consistent with order.

Superfund Site. ~~andremedial design that will lead to of the remedy selected in the Record of Decision (ROD).~~ The remedial action for the NW Natural and Siltronic sediments will be implemented in coordination with and following completion of any necessary upland NW Natural and Siltronic source control work being managed by DEQ.

- **Arkema** – Under an AOC with EPA, Arkema conducted additional site characterization and preliminary design evaluations for a planned Removal Action. ~~Data collected as part of this effort have been incorporated into the harbor-wide FS database for use in developing and evaluating alternatives~~. ~~Areas within and around the Arkema Removal Action Area.~~ ~~Although EPA and Arkema suspended the AOC in 2014, work on thehas continued with the intent for it to facilitate remedial design for the site subsequent to the ROD.~~

- **River Mile 11 East** - A group of Respondents, collectively known as the RM11 E Group (includes Glacier Northwest, Inc., Cargill, Inc., PacifiCorp, CBS Corporation, DIL Trust, and City of Portland), entered into an AOC to perform supplemental RI/FS~~remedial investigation and feasibility study~~ work in support of preliminary design activities. ~~Work completed in 2013/2014 within the RM11E Project Area included shallow sediment sampling, riverbank sampling, and upland groundwater monitoring well installation and sampling. Porewater sampler deployment is scheduled for August-October 2014. This information has not been included in the FS database.~~

In addition, a near-shore sediment removal adjacent to the BP Arco Bulk Terminal in 2007-08 under DEQ oversight resulted in 12,300 cubic yards of petroleum-contaminated soil and sediment being removed and disposed of off-site, and replaced with clean fill in conjunction with the installation of a new steel sheet-pile seawall along the entire riverbank of the BP Arco Bulk Terminal property.

1.2.3 Nature and Extent of Contamination

Due to the large number of contaminants detected at the Study Area~~site~~ in various media, the nature and extent of contamination focuses~~d~~ on specific contaminants or groups of contaminants selected by evaluating several criteria discussed in Section 5.1 of the RI. ~~The following contaminants were selected for evaluation in the RI:~~

- ~~Total polychlorinated biphenyls (PCBs)~~
- ~~Total Polychlorinated dibenzo-*p*-dioxins and furans (PCDD/Fs)~~
- ~~Total PAHs~~

Commented [KK139]: Accept edit.

Commented [KK140]: This information is moved to Section 1.3.

Commented [A141]: This language is unnecessary. The primary point is about what was included in the FS database.

Commented [KK142R141]: Agreed.

Commented [A143]: LSS does not agree that this statement is accurate.

Commented [KK144R143]: EPA agrees that this statement is no longer accurate.

Commented [A145]: Space between 11 and E? Needs to be consistent throughout.

Commented [KK146R145]: Agreed.

Commented [KK147]: Accept edit.

Commented [KK148]: This level of detail is not provided in other discussions, so was removed for consistency.

Commented [KK149]: This will be discussed in Section 1.3.

Commented [A150]: This is our understanding of EPA's intent. Regardless, each section should state the data status for each site for clarity.

Commented [KK151R150]: It is more a matter of timing. This data is not currently available as we are commencing on data evaluation in the FS so it will not be included. We will consider the data, however, to determine if there are any adjustments to the alternatives that are warranted, such as it impacts the acres and volumes beyond the +50/-30 FS evaluation.

Commented [A152]: Unclear what "entire" refers to.

Commented [KK153R152]: It was meant to encompass the entire frontage of the BP Arco Bulk Terminal property. Reject edit and added language to clarify.

Commented [KK154]: Accept edit.

Commented [A155]: The EPA revised version of this Section was not received until August 11, and therefore has not been incorporated into this review. Regardless, this section will need to be made consistent with the most up to date RI sections.

Commented [KK156R155]: This section is consistent with the edits made to RI Section 5. However, much of this has been removed.

Commented [A157]: As an example of consistency checks ...

Commented [KK158R157]: This list is consistent with Tab ...

Commented [CS159]: A larger issue is that the draft FS sect ...

Commented [KK160R159]: EPA disagrees. This section is ...

Commented [CS161]: Per LWG's 7/23/14 major issues ...

Commented [KK162R161]: This information is discussed i ...

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- ~~Total carcinogenic PAHs (cPAHs)~~
- ~~Total low molecular weight PAHs (LPAHs)~~
- ~~Total high molecular weight PAHs (HPAHs)~~
- ~~Benzo(a)pyrene~~
- ~~Naphthalene~~
- ~~Phenanthrene~~
- ~~Total DDx~~
- ~~Aldrin~~
- ~~Dieldrin~~
- ~~Chlordanes~~
- ~~gamma-Hexachlorocyclohexane (Lindane)~~
- ~~Tributyltin ion~~
- ~~Arsenic~~
- ~~Cadmium~~
- ~~Chromium~~
- ~~Copper~~
- ~~Lead~~
- ~~Mercury~~
- ~~Nickel~~
- ~~Zinc~~
- ~~TPH~~
- ~~Diesel-range hydrocarbons~~

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- ~~Residual-range hydrocarbons~~
- ~~Bis(2-ethylhexyl) phthalate~~
- ~~Butylbenzyl phthalate~~
- ~~Pentachlorophenol~~
- ~~Hexachlorobenzene~~

~~This list was further reduced in Section 5 of the RI to 14~~Fourteen indicator contaminants ~~in sediment~~ were discussed in detail in Section 5 of the RI report based on frequency of detection, ease of cross media comparisons, co-location with other contaminants, widespread sources, and similar chemical structures and properties. Information regarding ~~additional~~ the remaining contaminants ~~in sediment, surface water, and groundwater~~ is provided in Appendix D of the RI. The nature and extent of indicator contaminants in sediment~~,~~ and surface water~~, and river banks~~ are summarized in the following sections. As discussed in Section 5.1 of the RI, additional contaminants beyond the indicator contaminants presented in the RI (and summarized in this section) are present at the site at concentrations that may pose unacceptable risk to human health and the environment. Section 2.2.1 of the FS identifies the contaminants of concern (COCs) selected for the Portland Harbor Superfund Site and discusses the process for selecting the COCs. Groundwater is summarized in the subsections below because groundwater may impact decisions about sediment caps within the Site. Bank conditions are summarized because EPA may include some bank areas above elevation 13.3 feet North American Vertical Datum of 1988 [NAVD88] within the Portland Harbor Site based on future site-specific determinations. ~~Nature and extent of contaminated groundwater plumes is also discussed below; however, the contaminants in groundwater differ from the indicator contaminant list for sediment.~~

1.2.3.1 Sources

Historical and current locations of various industrial facilities identified along the lower Willamette River are provided by industrial sector in **Figures 1.2-5a** through **1.2-5j**. The approximate location of facilities is shown on the maps; however, the actual extent of historical and current facilities/operations is not shown. Detailed information regarding historic and current sources of contamination in the lower Willamette River is provided in Section 4 of the RI Report.

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Commented [A163]: Example of consistency comment above.

Commented [KK164R163]: There are 14 ICs discussed in Section 5 of the RI. The remainder of the contaminants are presented in appendix D. Not sure why this is deemed a consistency issue.

Commented [KK165]: Accept edit.

Commented [CS166]: This indicates that the text below will focus on the ICs, while subsections 1.2.3.3 and 1.2.3.4 discuss a much broader set of COIs that do not match the ICs. This has the potential to confuse the reader (e.g. TPH is not the same thing as TPAHs). The groundwater and bank descriptions should be limited to the ICs. And as noted above the sediment discussions should focus on the RAL contaminants.

Commented [KK167R166]: Since sediment and surface water were discussed in the RI report, the discussion focusses on the ICs. However, groundwater and river banks were not discussed in Section 5 of the RI report. Further, it is recognized that the contaminants in groundwater plumes differ from the IC list because they are localized occurances and did not meet the requirements of defining ICs in the RI. This does not imply that these are not important contaminants that need to be controlled and further provides a basis for needing PRGs developed so that EPA and DEQ can ensure that these sources are controlled adequately through monitoring programs.

Commented [CS168]: EPA requested at the July 31, 2014 meeting that LWG suggest the language for additional context on the source discussions. These edits are provided per that request.

Commented [KK169R168]: Remaining language in the paragraph is OK.

Commented [A170]: Again, we question that the addition of a many page figure from the RI streamlines the FS. We suggest that instead EPA cite the RI and not reproduce these figures here. Also, Figure 2.4-1 from the draft FS shows site ownership, which is similar.

Commented [KK171R170]: It is not a matter of "streamlining" the FS, but providing the information necessary to illustrate the discussion. Since the following issue discussed is contaminants associated with industrial sectors, not sources, so the reader needs to know where they are located. I didn't find the reference figures useful.

Commented [A172]: Appendix Q has more detailed information regarding current site sources. It should be cited here and generally used in the FS.

Commented [KK173R172]: Appendix Q is not being used in the revised FS.

Commented [KK174]: Reject edit.

Commented [A175]: Revisions to RI Section 4 and the FS regarding sources need to be made consistent.

Each of these industrial sectors is typically associated with the use of various chemicals. The contaminants are dependent upon the activities conducted, but the contaminants most commonly associated with each industry sector include the following:

Industrial Sector	**Common Industry Contaminants**
Ship Building, Dismantling, and Repair	Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), metals (e.g., Cu, Cr, Pb, Hg, Zn), phthalates, butyltins
Wood Products and Wood Treating	VOCs, SVOCs, TPH, benzene, PAHs, metals (e.g., As, Cr, Cu, Zn), pesticides, fungicides, biocides, borates, pentachlorophenol, creosote, acid/alkaline wastes, dioxins
Chemical Manufacturing and Distribution	Vary depending on the operations, but chemical manufacturing known to have occurred within Portland Harbor includes pesticides, herbicides, VOCs, SVOCs, dioxins/furans, metals, PCBs, solvents, acid/alkaline wastes, benzene, TPH, and PAHs
Metal Recycling, Production, and Fabrication	VOCs, SVOCs, TPH, PCBs, PAHs, heavy metals, asbestos, cyanide, phthalates, fuel and fuel additives, n, battery acid, oil and grease, lubricants, paint pigments or additives, ionizing radioactive isotopes, transmission and brake fluids, lead acid, antifreeze, benzene, chemical residue, heating oil, solvents
Manufactured Gas Production	VOCs including benzene, toluene, ethylbenzene, and xylenes (BTEX), SVOCs, PAHs, TPH, metals, and cyanide
Electrical Production and Distribution	PCBs, TPH, and PAHs
Bulk Fuel Distribution and Storage, and Asphalt Manufacturing	VOCs (benzene), SVOCs, PAHs, TPH, metals, gasoline additives (methyl tert-butyl ether [MTBE], ethylene dibromide [EDB], ethylene dichloride [EDC])
Steel Mills, Smelters, and Foundries	Metals, TPH, PAHs, PCBs, fuel additives, chlorinated solvents (VOCs)

Commented [KK176]: Reject edit.

Commented [A177]: In instances where the RI is still being finalized, information needs to be made consistent between RI and FS. For example: Section 3.2.3 of 2014 RI discusses how the contaminants actually vary and are "dependent upon the activities conducted".

Commented [A178]: The lists of contaminants here should be made consistent with the RLSO contaminant additions in the 2014 RI. There are multiple inconsistencies. Also, the additional language from the RI such as "can be associated with" and "dependent on the activities conducted" should be copied here.

Commented [KK179R178]: Agreed.

Commented [A180]: 2014 RI lists out specific metals including Cu, Cr, Zn, Pb, Hg

Commented [elb181]: Accept edit. Change made.

Commented [KK182]: Accept edit.

Commented [CS183]: What is this supported by?

Commented [KK184R183]: As cited in the RI, references EPA 2006g,h,i,j. Removed since it is not relevant.

Commented [A185]: The 2014 RIA text provides a citation for MGP contaminants.

Commented [KK186R185]: Noted.

Industrial Sector	Common Industry Contaminants
Commodities Maritime Shipping and Associated Marine Operations	Spillage of raw materials during transport to and from vessels, butyltins, metals, TPH, fuel additives, chlorinated solvents (VOCs)
Rail Yards	VOCs, SVOCs, TPH, PCBs, and heavy metals

Commented [A178]: The lists of contaminants here should be made consistent with the RLSO contaminant additions in the 2014 RI. There are multiple inconsistencies. Also, the additional language from the RI such as "can be associated with" and "dependent on the activities conducted" should be copied here.

Commented [KK179R178]: Agreed.

Commented [CS187]: This is another example of text that needs to be made consistent with the RI, in this case Section 3.2.3.1. EPA agreed there to include wording that the contaminants are "dependent upon the activities conducted but could include PCBs, oil and grease, lubricants, paint pigments or additives, transmission and brake fluids, fuel, battery acid, lead, antifreeze, chemical residue, petroleum products, solvents, asbestos, phthalates, and heavy metals (EPA 2006m, footnote 20)".[emphasis added].

Commented [KK188R187]: Emphasized language included in intro to this table.

Contaminants released during industry operations and/or other activities to the air, soil, groundwater, surface water, and/or impervious surfaces can potentially migrate to the lower Willamette River via the following pathways: direct discharge, overland transport, groundwater, riverbank erosion, atmospheric deposition, overwater activities, and upstream watershed.

One key migration pathway for contaminants from these various industries to migrate to the river was through direct discharge via numerous public and private outfalls, including storm drains and combined sewer overflows, which are located along both shores of the lower Willamette River in the metropolitan area. In the early 1900s, rivers in the United States were generally used as open sewers, which was also true for the Willamette (Carter 2006). The process water from a variety of industries, including slaughterhouses, chemical plants, electroplaters, paper mills, and food processors, was discharged directly into the river. In the 1950s, municipal conveyance systems included interceptors and associated facilities were installed to reduce the volume of untreated sewage discharging to the Willamette from the City of Portland and regulatory actions in the 1960s and 1970s, such as the Clean Water Act, gradually reduced the direct discharge of waste to the Willamette River.

Commented [KK189]: Accept edit.

Commented [A190]: This phrase was struck from the 2014 RI Section 4.3.1.

Commented [KK191R190]: Agreed. This also needs to be stricken from RI Section 1.

Historical releases from upland or overwater activities within the Study Area likely contributed to the majority of the observed contaminant distribution in sediments within the Study Area. The majority of current contaminant pathways to the river (soil erosion, groundwater, and stormwater) from upland sources are a result of historical operational practices, spills, and other releases.

Commented [CS192]: We assume this is what was meant.

Commented [KK193R192]: Agreed. Accept edit.

In addition, point and nonpoint discharges within the Willamette River Basin are potential sources of contamination in sediment, surface water, and biota in the Study Area. Contaminants in discharges and runoff from diverse land uses in the basin eventually enter the river upstream of the Study Area. Contaminant loading from sediment transport and water from upstream areas throughout the last century also contributed to the conditions currently observed in the Study Area.

Commented [A194]: This is not site history and could be moved to Section 1.2.1 or to a discussion of sources.

Commented [KK195R194]: Agree that it should be moved but disagree with section suggested. Moved to this location.

Commented [A196]: There is no real doubt about this.

Commented [KK197R196]: OK.

~~1.2.3.1~~1.2.3.2 Sediment

Sediment samples were collected ~~throughout~~ from the Study Area for consideration in the FS. The majority of the sampling was conducted by the LWG under the terms of AOC and consistent with EPA approved work plans, ~~from~~ 1997~~2002~~ to 2013~~, although, except for the LWG rounds of study, most of these data collection efforts focused on small areas of the site~~. Sample locations were biased toward areas of known or suspected contamination based on existing information.~~, with a~~Additional sampling was conducted both upstream and downstream of the Study Area. Summary statistics of surface and subsurface sediment results for the contaminants presented above are provided in **Table 1.2-1**. ~~With few exceptions~~Generally, concentrations of the contaminants~~IC~~ were greater in subsurface sediment samples relative to surface samples, confirming that historical inputs were greater than current inputs. However, there are noted areas within the Study Area where surface concentrations are greater than subsurface concentrations indicating localized areas with current inputs. ~~A summary of the 14 indicator contaminants presented in the RI is presented below.~~

PCBs

With few exceptions, the highest PCB concentrations in surface sediment are present in nearshore areas outside the navigation channel and proximal to currently known or suspected sources (**Figure 1.2-5a**). Similar spatial and concentration trends are observed for subsurface sediments (**Figure 1.2-5b**). Total PCB concentrations are typically greater in the subsurface than in surface sediments, indicating PCB sources are primarily historical. Overall, surface sediment PCB concentrations in the Study Area are ~~significantly~~ greater than those in the upriver (upstream of Ross Island) and downstream (mainstem of the lower Willamette River downstream of RM 1.9 and Multnomah Channel) reaches.

Dioxins/Furans

Total PCDD/Fs were detected at several locations along the eastern and western nearshore zones and in Swan Island Lagoon (**Figure 1.2-6a**). ~~The spatial resolution of~~ Limited surface PCDD/F data ~~are limited.~~are available; thus, ~~for the navigation channel and~~ spatial resolution is somewhat limited, especially in the navigation channel. Total PCDD/F concentrations in the subsurface are generally greater than that observed in surface sediments (**Figure 1.2-6b**). The higher concentrations ~~typically~~generally observed in subsurface sediment relative to concentrations in surface sediment are indicative of a primarily historical input of these contaminants to the Study Area.

DDx

The highest reported DDx concentrations in surface sediments are present in localized areas in the western nearshore zones between RMs ~~7~~6.3 and 7.5 (**Figure 1.2-7a**). DDx concentrations are typically greater in the subsurface than in the surface layer,

Commented [elb198]: Agree. The reference should be with respect to data used in the FS

Commented [A199]: The FS database currently includes data back to 1997

Commented [KK200R199]: This is not about the FS database. This is about the data collected by the LWG for the RIFS, which extends further back than 1997.

Commented [A201]: These dates will need to be checked against the actual final FS database.

Commented [KK202R201]: Added language for clarity. Section 1.3 will have description of FS database.

Commented [CS203]: The phrase "throughout the Study Area" implies that there are site-wide data sets throughout this period, which is misleading.

Commented [KK204R203]: Added language for clarity.

Commented [A205]: Unclear what this table is. No description was provided by EPA.

Commented [KK206R205]: Description provided in attachment (Excel sheet) with this version of document.

Commented [KK207]: There are more than a few exceptions.

Commented [KK208]: We cannot use this acronym to represent indicator contaminants since it has been already used in the BHHRA and has a different meaning.

Commented [A209]: With the exception of BEHP, all of the ICs were greater in subsurface sediment than surface sediment. This observation confirms greater historical inputs to the site as opposed to current inputs, and this important conclusion should be called out in this paragraph, rather than buried in each individual subsection.

Commented [KK210R209]: Agree with this statement as "generally" but the RI notes various areas where this is not the case. While we do not agree that the discussions are buried in each individual section (since each is just a paragraph), it is agreed that a general statement could be made upfront.

Commented [A211]: Per agreements during FS Section 1 discussions, this figure and those like it will be directly from the I ...

Commented [KK212R211]: Agreed. Spreadsheet has been ...

Commented [CS213]: The draft FS had subsurface chemical ...

Commented [KK214R213]: Agree that subsurface maps ...

Commented [A215]: This term was added to the draft FS tex ...

Commented [KK216R215]: Accept edit.

Commented [KK217]: Accept edit.

Commented [CS218]: Is this referring to spatial resolution i ...

Commented [KK219R218]: The number of sediment ...

Commented [KK220]: Reject edit. As stated above, there is ...

Commented [A221]: The "highest" concentrations are locali ...

Commented [KK222R221]: Consistent with the RI report ...

indicating DDx sources are primarily historical (**Figure 1.2-7b**). The concentrations of DDx in surface sediments are greater in the Study Area than those in the upriver, downtown, Multnomah Channel, and downstream reaches.

Total PAHs

The highest reported concentrations of total PAH in surface sediments generally occur in the western nearshore zone downstream of RM 6.8~~7~~, and on the east side at approximately RM 4.5 (**Figure 1.2-8a**). Total PAH concentrations are generally higher in subsurface sediments within the ~~Site~~ Study Area as a whole, pointing to higher historical inputs to the ~~Site~~Study Area (**Figure 1.2-8b**). Within the Study Area, total PAHs in sediment are generally dominated by HPAHs. Surface sediments from the western nearshore zone appeared to exhibit higher proportions of LPAHs than sediments from the eastern nearshore zone and the navigation channel, but follow the general trend of HPAH dominance. Subsurface generally exhibit similar PAH profiles to the surface sediments.

Bis(2-ethylhexyl) phthalate

The highest reported concentrations of bis(2-ethylhexyl) phthalate were observed in samples collected in surface and subsurface sediment from the eastern nearshore in Swan Island Lagoon, ~~and~~ between RM 3.8 and 4.1, and in the International Terminals Slip (**Figures 1.2-9a and 1.2-9b**).

Total Chlordanes

The highest reported concentrations of total chlordanes were observed along the western nearshore zone between approximately RM 7~~6~~ and 9~~7.4~~ (**Figure 1.2-10a**). Total chlordane concentrations are generally higher in subsurface sediments within the Site, pointing to higher historical inputs to the Site (**Figure 1.2-10b**).

~~**Lindane**~~

~~Detected concentrations of gamma-hexachlorocyclohexane (Lindane) were generally lower within the navigation channel (**Figure 1.2-11**). The highest reported sediment concentrations were reported from samples along the western nearshore zone between approximately RM 6 and 7.4.~~

Aldrin and Dieldrin

Aldrin and dieldrin, have similar chemical structures and are discussed together here because aldrin readily undergoes biotic and abiotic transformation to dieldrin~~quickly breaks down into dieldrin in the environment~~. The highest reported concentrations of aldrin were observed in the western nearshore zone ~~around~~ from RM 6.8 to RM 7~~.4~~ and ~~the western nearshore zone~~ at RM 8.8 (**Figures 1.2-1~~12~~a ~~and 1.2-13~~**). The highest reported surface concentrations of dieldrin were observed in Swan Island Lagoon and in the western nearshore zone from RM 8 to 9 (**Figure 1.2-12a**). Aldrin and dieldrin

Commented [KK223]: Accept edit.

Commented [KK224]: Accept edit.

Commented [KK225]: Accept edit.

Commented [KK226]: Accept edit.

Commented [CS227]: It is unclear how EPA arrived at this river mile range. For example, high detections of chlordane occur RM 8.8 as well. Also, there are multiple non-detects of chlordane within this river mile range.

Commented [KK228R227]: Changes made to be consistent with RI.

Commented [CS229]: Again, the focus on this river mile range is unclear. There were many non-detects of Lindane in this broad river mile range.

Commented [KK230R229]: Removed discussion. Lindane was not discussed in Section 5 the RI report.

Commented [CS231]: Dieldrin is not elevated here. Again, the determination of these RM ranges is unclear.

Commented [KK232R231]: Changes have been made to be consistent with the RI report.

concentrations are higher in subsurface sediments than surface sediments within the Site (**Figures 1.2-11b and 1.2-12b**), pointing to higher historical inputs to the Study Area.

Metals

The highest reported arsenic concentrations were reported in several locations in the eastern nearshore at RM 2.3, RM 5.6~~7~~, RM 7.2, near the mouth of Swan Island Lagoon, and in the western nearshore area ~~of~~ at RM 6.8, RM 8.6~~9~~, and ~~to~~ RM 10.2~~3~~ (**Figure 2.1-13a~~4~~**). Arsenic concentrations are generally greater in the surface sediments than in subsurface sediments within the Study Area (**Figure 1.2-13b**).

The highest reported chromium concentrations were observed in the eastern nearshore zone at~~in~~ RM 2.1-2.4, RM 3.7-4.4, RM 5.6-5.9, and in Swan Island Lagoon, and in the western nearshore zone at~~in~~ RM 6-6.1, RM 6.8-6.9, and RM 8.8- ~~RM~~ 9.2 (**Figure 2.1-14a~~5~~**). Chromium concentrations are generally greater in the surface sediments than in subsurface sediments within the Study Area (**Figure 1.2-14b**).

The highest surface and subsurface copper concentrations were observed in the eastern nearshore zone at RM 2.1-2.4, RM 3.7-4, RM 5.5-6.1, RM 11.1-11.3, and Swan Island Lagoon, and in the western nearshore zone from RM 4.3 through 10.4 (**Figure 1.2-15a**). Copper concentrations are generally ~~higher~~ similar in surface and subsurface sediments in ~~than surface sediments within the Site, pointing to higher historical inputs to~~ the Study Area (**Figure 2.1-15b~~6~~**).

The highest surface ~~and subsurface~~ sediment zinc concentrations were found in the eastern nearshore zone at RM 4-4.6, RM 5.6, and RM 6.7, and the western nearshore zone between RM 8~~.2~~ and 9.2 (**Figure 2.1-16a~~7~~**). The highest subsurface concentrations of zinc were found in the western nearshore zone at RM 9-9.2 and in Swan Island Lagoon (**Figure 1.2-16b**). Zinc concentrations are generally similar in the surface sediments and subsurface sediments within the Study Area.

Tributyltin Ion

The highest concentrations of tributyltin were reported in surface sediment near the eastern nearshore zone ~~between~~ at RM 3.7,~~8 and~~ RM 7.5~~9~~, and ~~near the entrance to the International Terminals Slip near RM 3.7~~in Swan Island Lagoon (**Figure 2.1-17a~~8~~**). The highest subsurface concentrations of zinc are found in the eastern nearshore zone between RM 7 and RM 8, and in Swan Island Lagoon (**Figure 2.1-17b**). Concentrations are generally higher in subsurface sediments than surface sediments within the Site, pointing to primarily historical inputs to the Study Area.

Commented [CS233]: It is unclear that these figures completely support these statements.

Commented [KK234R233]: Changes have been made to be consistent with the RI report.

~~1.2.3.2~~1.2.3.3 Surface Water

Concentrations of contaminants in surface water samples varied both spatially and with river flow. Surface water sample locations with the highest reported contaminant concentrations are as follows:

Commented [CS235]: We could not verify the accuracy of this table because firstly the source of these findings are not discussed (e.g., from the RI or some other analysis?). Second, the term "highest" is not clear. For example, what threshold level for each chemical was used to determine that the chemical should be listed for the locations shown in this table? How were different sampling events at the same locations interpreted?

Commented [KK236R235]: The term highest is a relative term, similar to sediment concentrations. It is values that were observed at the upper end of the concentration range. There was no differentiation between sampling events – all data was evaluated.

River Mile	River Location	Sample ID	Contaminants
MC	Transect	W027	PCDD/Fs, aldrin, copper
2	East	W001	PCBs, DDx
	West	W002	chlordanes
	Transect	W025	PCBs, BEHP, aldrin
3	International Slip	W004	PCBs
	East	W028	PCBs
4	West	W029	BEHP, chlordanes
5	East	W030	PCBs, DDx, chlordanes
6	East	W013, W014, W032	PCBs, PCDD/Fs
	West	W015, W031	PCBS, PCDD/Fs, DDx, PAHs, chlordanes, aldrin, dieldrin, copper
	Transect	W011	PCDD/Fs, BEHP, aldrin
7	West	W016, W033	PCBs, PCDD/Fs, DDx
8	West	W019, W036	PCBs, PAHs, BEHP
9	West	W022, W037	DDx, zinc
11	Transect	W023	PCDD/Fs, chlordanes, copper
16	Transect	W024	BEHP, copper

RM 7E was not sampled.
RM 8E was not sampled.
RM 9E was not sampled.
RM 10 was not sampled.

~~Locations where surface sample results exceed ambient water quality criteria are presented on Figure 1.2-19~~. Concentrations of contaminants in surface water within the

Commented [A237]: Per FS Section 1 discussions, EPA agreed to remove this figure, given it does not provide information of the distributions of contaminants, which is the subject of this paragraph.

Commented [KK238R237]: OK.

Study Area are~~were~~ generally higher than those entering the upstream limit of the Study Area (W024 at RM 16) under all flow conditions. The highest contaminant~~s~~ concentrations in surface water within the Site were found near known sources~~ of these either in sediments or upland (e.g., stormwater outfalls)~~. At the downstream end of the Study Area, RM 2 (W001, W002, W025) and Multnomah Channel (W027), ~~the downstream end of the Study Area, ~~concentrations of total PCBs, dioxin/furans, DDx, BEHP, chlordanes, and aldrin ~~and copper ~~in surface water are greater than concentrations entering the Study Area that indicate contamination from Portland Harbor is being transported downstream ~~ reflect discharge of these contaminants ~~to the Columbia River.

~~1.2.3.3~~1.2.3.4 Groundwater

Figure 1.2-18a through Figure 1.2-18h~~20~~ and **Figure 1.2-19~~21~~** (inset of the Doane Lake area) show the nature and extent of known contaminated groundwater plumes currently or potentially~~have the potential of~~ discharging to the river. Cleanup of contaminated groundwater is being managed by DEQ under an MOU with EPA. The following provides a discussion of the groundwater plumes presented in **Figures 1.2-18a through 1.2-18h~~20~~** and **1.2-19~~21~~~~7~~**:

East Side of Willamette River

RM 2

Evraz Oregon Steel Mill – ~~The potential for a manganese plume is being evaluated at the site, but has not been confirmed.~~Contaminants detected in groundwater above screening levels are manganese and arsenic. Arsenic concentrations in beach monitoring wells exceed MCLs. Manganese was detected in beach wells at concentrations exceeding aquatic life screening criteria. Further evaluation of groundwater discharge at the Evraz Oregon Steel Mill site is ongoing.

RM 3.5

Time Oil – Contaminants are pentachlorophenol, arsenic, gasoline- and diesel-range hydrocarbons. A pump and treat system is operating to prevent migration of the pentachlorophenol plume from reaching the river via a stormwater outfall and prevent offsite migration to the Premier Edible Oils property. There are three TPH plumes identified at this site; the northern plume is not discharging to the river, the middle plume is discharging to the river, but arsenic is the only contaminant with~~for which~~ concentrations exceed~~d~~ing SLVs. The southern upland plume migrates a short distance onto the Premier Edible Oils property and is not discharging to the river.

Premier Edible Oil – Contaminants are TPH (diesel-range hydrocarbons), manganese, and arsenic.

Commented [KK239]: Accept edit.

Commented [CS240]: It is unclear what is meant by "reflect discharge". What does this mean about the concentrations: are they higher or lower than elsewhere? And what is being implied about discharge to the Columbia?

Commented [KK241R240]: Modified sentence to add clarity.

Commented [CS242]: Groundwater is not within the Study Area. This discussion should be moved to a section that is clearly about sources outside the study area, rather than being in a section about site nature and extent.

Commented [CS243]: As previously stated in our 7/23/14 statement of major issues, we continue to disagree with abandoning the information and approach presented in Appendix Q of the 2012 draft FS report. The rationale for the concern and disagreement is that these sections on migration pathways are either incomplete, inconsistent, or unclear on the rationale for inclusion. For example, why aren't the migration pathways of storm water, overwater, and overland transport presented in this section? All of these pathways are part of the DEQ milestone reporting, RI relevant sections (section 4), and appendix Q of the 2012 draft FS.

Commented [A244]: Again, these figures refer to the Milestone report. We assume they would refer to the DEQ Summary Report that is due out in Fall 2014 instead. Also, the figure from the milestone report does not clearly indicate nature and extent of the groundwater plumes.

Commented [KK245R244]: Agree. Reference has been updated.

Commented [CS246]: Redundant with plumes.

Commented [KK247R246]: Disagree. Reject edit.

Commented [KK248]: Accept edit.

Commented [CS249]: It is unclear how this description/definition functionally is used to identify which groundwater conditions are included or excluded for the groundwater pathway here. It does not appear to capture or ...

Commented [KK250R249]: Information was added to the introduction of this section as to the intent of presenting this ...

Commented [CS251]: We are unable to check or otherwise verify any of the information in this section because it relies on a ...

Commented [KK252]: Reject edit.

Commented [CS253]: Inclusion of arsenic and use of the MCL for arsenic is in inappropriate. First, EPA has agreed in ...

Commented [KK254R253]: Reject edit. Discussion has been limited to factual statements regarding comparison to screening ...

Commented [CS255]: Arsenic is not a COI associated with site activites at TOC's Northwest Terminal. We believe that arsenic ...

Commented [KK256R255]: Disagree with comment regarding arsenic. Arsenic was detected in site groundwater. The assessme ...

Commented [KK257]: Accept edit.

Commented [KK258]: Accept edit.

Schnitzer Steel Industries – A halogenated VOC plume is known to be discharging to the river. Contaminants include cis-1,2-dichloroethene (cis-1,2-DCE), tetrachloroethene (PCE), and trichloroethene (TCE).

RM 4.5
NW Pipe – A halogenated VOC plume is known to discharge to the river. Contaminants include PCE, TCE, and vinyl chloride.

Terminal 4 Slip 3 – Contaminants include TPH (diesel-range hydrocarbons). Source control measures to address contaminated groundwater discharges have been completed and monitoring is ongoing.

Commented [A259]: Per the global comment above regarding selection of pathways and their status, the groundwater pathway for Terminal 4 Slip 3 should be removed because the source control measure has been implemented and ongoing monitoring continues to demonstrate this pathway is no longer complete.

Commented [KK260R259]: Reject edit. Added statement that source has been controlled.

RM 6
McCormick & Baxter Creosote Co. – Contaminants include pentachlorophenol ~~(PCP)~~, PAHs, arsenic, chromium, copper, and zinc. An upland groundwater barrier wall system and in-river sediment cap has been installed that isolates contaminated groundwater from the river. A 5-Year Review completed in 2011 by EPA and DEQ determined constructed remedies are protective to human health and the environment.

Commented [KK261]: Accept edit.

RM 11
Tarr Oil – A halogenated VOC plume is not known to be releasing to the river. Contaminants include cis-1,2-DCE, PCE, TCE, and vinyl chloride

Commented [KK262]: Accept edit.

West Side of Willamette River

RM 4
Kinder Morgan Linnton Bulk Terminal – A TPH plume is located onsite and has released to the river. Contaminants include LNAPL, diesel-range hydrocarbons, residual-range hydrocarbons, and gasoline-range hydrocarbons. A sheet-pile wall has been constructed to prevent LNAPL migration to the river.

RM 5
BP Arco Bulk Terminal – A TPH plume has discharged to the river. Contaminants include TPH (gasoline-range and diesel-range hydrocarbons) and LNAPL, and the plume extends under the adjacent downstream property. A sheet-pile wall with groundwater hydraulic control system is in place. A groundwater pump and treat system and LNAPL recovery system is in use.

Exxon Mobil Bulk Terminal – A TPH plume has discharged to the river. Contaminants include gasoline- and diesel-range hydrocarbons. A bentonite wall has been constructed along the riverbank for the majority of the site. A groundwater pump and treat system is in place and operating at the downstream end of the site where the cutoff wall is absent. Treatment of the source areas via air sparging is ongoing.

RM 5.5
Foss Maritime/Brix Marine – TPH releases from underground storage tanks (USTs) have been identified onsite. Contaminants include gasoline- and diesel-range hydrocarbons.

RM 6
NW Natural/Gasco – Goundwater plumes associated with historical MGP waste are known to be discharging to the river. Contaminants detected in groundwater include PAHs, SVOCs, VOCs (e.g., benzene, ethylbenzene, toluene and xylene – BTEX), cyanide, sulfide, sulfate and carbon disulfide, ammonia, and metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc). Gasoline- range hydrocarbons, diesel- range hydrocarbons, residual-range hydrocarbons and total petroleum hydrocarbon fractions are being added to the groundwater monitoring program.~~Contaminants include PAHs, SVOCs, VOCs, gasoline- range hydrocarbons, diesel- range hydrocarbons, residual-range hydrocarbons, cyanide, sulfide and carbon disulfide, aluminum, ammonia, iron and metals.~~ A hydraulic control pump and treatment system has been constructed at the riverbank and is currently being tested.

RM 6 and RM 7
Siltronic – A chloinated VOC plume as well as goundwater plumes associated with historical MGP waste and pesticide plumes from Rhone Poulenc are known to discharge to the river. Contaminants include petroleum-related and chlorinated VOCs (benzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,1-dichloroethene, cis-1,2-DCE, trans-1,2-DCE, TCE, and vinyl chloride), PAHs, gasoline- range, diesel-range, and residual-range hydrocarbons, cyanide, metals (arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, thallium, vanadium, and zinc), Silvex, and dichlorprop. In-situ bioremediation and treatment with zero-valent iron has been implemented to reduce halogenated VOC concentrations discharging to the river. The NW Natural hydraulic control pump and treatment system extends to the northern portion of the Siltronic site is expected to control the TCE plume in addition to the Gasco MGP plume.

RM 7
Rhone Poulenc – Known releases of organochlorine insecticides and herbicides, including PCP, 2,4-DP, Bromoxynil, 4(2,4-dichloropenoxy)butyric acid (2,4-DB), 2-methyl-4-chlorophenoxyacetic (MCPA), methylchlorophenoxypropionic acid (MCPP), 4-(4-chloro-2-methylphenoxy)butanoic acid (MCPB), 2,4,5-trichlorophenoxyacetic acid

Commented [CS263]: This selection of contaminants is not consistent with known data on substantial groundwater plumes at the site, and the basis for it is unclear. For example, data indicate BTEX compounds are present in groundwater plumes, and BTEX is not mentioned. Conversely, the presence of clear plumes or substantial discharges of the other contaminants highlighted by this comment is not well supported by the site datasets except for iron.

Commented [KK264R263]: Disagree with comment. The purpose of the paragraph is to state what chemicals were detected. The list of chemicals detected in groundwater has been updated based on ODEQ input.

Commented [CS265]: Also a global comment for the groundwater and bank sections is that there is great variation on when "metals" are referred to versus individual metals are listed.

Commented [CS266]: The LWG cannot confirm the accuracy of this text without more specific information on how this text was developed. Once that information is available, the LWG will most likely have specific edits to this section."

Commented [KK267R266]: Appendix C2 of the RI.

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[2,4,5-T], 2,4-dichlorophenoxyacetic acid (2,4-D), DDT, Endrin, Heptachlor, sodium chlorate, sodium arsenate, 2,4,5-TP (Silvex), aldrin, dieldrin, chlordanes, and dichlorprop have occurred at the site~~are known to discharge to the river. Additional contaminants include 1,2-dichlorobenzene, chlorobenzene, 1,3-dichlorobenzene, benzene, DDx, and dioxins/furans.~~

Spatial and temporal uncertainty present in the groundwater dataset for the site results in uncertainty in defining the full extent of the groundwater plume. DEQ determined that there is clear evidence that source control is needed to address direct discharge to the River of the following contaminants in groundwater: VOCs (e.g., dichlorobenzene isomers, and chlorobenzene), and herbicides (e.g., Silvex and dichlorprop). The plume is uncontrolled (ODEQ 2013).

The City Outfall 22B groundwater infiltration pathway is currently being addressed through implementation of the Outfall 22B Expanded IRAM. The Outfall 22B Expanded IRAM is being implemented to address exceedances of Joint Source Control Screening Level Values for the following in dry weather flow: SVOCs (2,4,6-trichlorophenol, 2,4-dichlorophenol, 2-methylphenol, pentachlorophenol, and naphthalene), Insecticides (aldrin, alpha-chlordane, deldrin, gamma-chlorodane, heptachlor epoxide, hexachlorobenzene, DDD, DDE, and DDT), Dioxin/furans (2,3,7,8-TCDD) and metals (aluminum, boron, molybdenum, thallium, arsenic, barium, iron, manganese) (ODEQ 2013b).

Kinder Morgan Pump Station – A TPH plume has been identified at the pump station. The extent of the plume is currently unknown.

Arkema – Contaminants detected in groundwater at the site include, but are not limited to, DDT and its metabolites DDD and DDE (DDX) and VOCs (MCB, chloroform, PCE, TCE and benzene), perchlorate and hexavalent chromium). The DDX and MCB are primarily associated with pesticide manufacturing process residue (MPR). Perchlorate and hexavalent chromium are associated with the Chlorate Plant area. ~~A DDT and halogenated VOC plume is located on the northern section of the property and discharges to the river. On the southern end of the property, several plumes containing DDT, chlorobenzene, PCE, chloroform, hexavalent chromium, perchlorate, chlorinated furans, and salts also discharge to the river. Investigation of the VOC plume is ongoing.~~ A barrier wall and groundwater pump and treat system is being constructed to manage the groundwater plumes on the southern end of the property and is currently being tested. Additional source control measures to address groundwater impacts north of the groundwater containment system will be evaluated in the Arkema upland FS.

RM 8~~9~~

Commented [CS268]: The LWG cannot confirm the accuracy of this text without more specific information on how this text was developed. Once that information is available, the LWG will most likely have specific edits to this section."

Commented [KK269R268]: Updated based on ODEQ input. Reference provided.

Commented [CS270]: The LWG cannot confirm the accuracy of this text without more specific information on how this text was developed. Once that information is available, the LWG will most likely have specific edits to this section."

Commented [KK271R270]: Revised to reflect statements from Appendix C2 of the RI.

Commented [KK272]: Reject edit. Corrected to RM 8.

Kinder Morgan Willbridge Bulk Terminal – A TPH plume is not known to be currently discharging to the river. Contaminants include gasoline- range hydrocarbons, diesel-range hydrocarbons, residual-range hydrocarbons, and arsenic. Evaluation of the plume is ongoing.

Chevron and Unocal Willbridge Bulk Terminal – A TPH plume located onsite has discharged to the river. Contaminants include LNAPL, gasoline- range hydrocarbons, diesel- range hydrocarbons, residual-range hydrocarbons, and metals (arsenic and manganese). Nineteen control measures have been implemented at the site between the early 1970s and 2010 to address the potential migration of impacted groundwater to the Willamette River. Saturated petroleum hydrocarbon (SPH) contamination has been detected at various locations across the site. Observations of sheen associated with r~~R~~ecent high groundwater conditions ~~have identified some~~has raised concerns ~~with~~ regarding the long-term adequacy of the LNAPL containment system; additional characterization is in progress, and it is expected that modifications to the LNAPL containment system will be proposed.

Commented [CS273]: A reference for this is needed. This is not in any currently available information that we can find.

Commented [KK274R273]: Information has been updated based on presentation from March 2014 and input from ODEQ.

Chevron Asphalt Plant – Free product consisting of relatively immobile asphalt-related petroleum has been noted on site. Contaminants include TPH (diesel-range and gasoline-range hydrocarbons), arsenic, BTEX and napthalene. DEQ has concluded that the plume is not discharging to the river.

RM 9

Commented [KK275]: Accept edit.

Gunderson ~~– There are two known groundwater plumes at the Gunderson property.~~ There is ~~A~~a chlorinated VOC plume (1,1-DCE, 1,1,1-trichloroethane [1,1,1-TCA], PCE, TCE and vinyl chloride) near the downstream end of the Gunderson property.~~, and PAH plume located between the Equilon (Shell Terminal) pipeline gasoline release and the Equilon dock at Gunderson.~~ An air sparge/soil vapor extraction~~AS/SVE~~ and a pump and treat system were operating for the VOC plume. DEQ approved the shut-down of the~~se~~ pump ant treat system~~s~~ and a rebound assessment is in progress~~schedule of expanded groundwater monitoring~~.

Commented [KK276]: Accept edit.

In addition, there is a PAH groundwater plume located between the Equilon (Shell Terminal) pipeline gasoline release and the Equilon dock at Gunderson. ~~Equilon (Shell Terminal) A PAH plume is located between the Equilon (Shell Terminal pipeline gasoline release and the Equilon dock at Gunderson.~~ The PAH plume was determined by DEQ to not be discharging to the river. Shell treated a gasoline release from their pipeline on the Gunderson site using an air sparge and vapor recovery system. This system has been shut down and dismantled. DEQ approved the cleanup and issued a NFA.

Christensen Oil – A TPH (Stoddard solvent) plume is located onsite. The plume extent is not known to currently discharge to the river since a dual phase extraction and treatment system is currently operating to control migration of the plume. Evaluation of the control is ongoing.

Univar – A VOC plume is located onsite. Contaminants include 1,1-DCA, 1,1-DCE, cis-1,2-DCE, methylene chloride, PCE, toluene, 1,1,1-TCA, TCE, vinyl chloride, and xylenes, . The plume does not extend to the river. Soil vapor extraction and pump and treat systems have been implemented as interim corrective measures.

Galvanizers Inc. – A zinc plume located at this site is not known to currently discharge to the river. The plume may have infiltrated the storm water system that discharged to the river; however, that system has been diverted to the City Big Pipe project.

RM 10
Sulzer Pump – TPH, PAH, and VOC plumes from UST and waste oil UST releases exists at this site.

RM 11.5
Centennial Mills – A TPH (diesel-range hydrocarbons) plume is located at this site. The plume is not known to discharge to the river, but may be infiltrating the Tanner Creek sewer line near the river.

~~1.2.3.4~~1.2.3.5 River Banks

~~**Figure 1.2-7** shows the nature and extent of known or suspected contaminated river banks within the Study Area.~~ Identification of contaminated banks is being managed by DEQ under an MOU with EPA. The following provides a discussion of the known contaminated banks:

East Side of Willamette River

RM 2
Evraz Oregon Steel Mill – Contaminants~~tion~~ present in the riverbank ~~is~~ includes PCBs and metals (arsenic, cadmium, chromium, copper, lead, manganese, and zinc). A source control measure to remove, cap and stabilize contaminated riverbank material is currently in the design phase.

RM 3.5
Schnitzer Steel Industries – Results of soils samples collected under the docks along the south shore of the International Slip indicate that contaminants are PCBs and dioxins.

RM 5.5

Commented [CS277]: This term should be defined here. Is EPA referring to bank areas outside of the Study Area (above NAVD88 13.3 ft) within the study area (below this elevation) or both?

Commented [KK278R277]: Both.

Commented [CS279]: Similar to the comment about groundwater, this appears to include information from outside the Study Area and therefore should be in a section clearly about external sources, not be in a site nature and extent section.

Commented [KK280R279]: Language has been added to intro of this section to describe intent of including this information.

Commented [A281]: A description of this figure was not provided. (This figure number refers to a DDx sediment figure that does not show bank contamination.) This section cannot be fully reviewed without this figure.

Commented [KK282R281]: Sentence deleted.

Commented [CS283]: Per the comment above on the selection of groundwater pathways to include, it is unclear how this definition was used to include or exclude this river bank pathway or whether or not this is consistent with the previous methods used in the DEQ milestone reports, the RI, or the draft 2012 FS.

Commented [CS284]: As another example of the unclear sources of information, Appendix Q of the draft FS lists "PCBs and metals" for the bank migration pathway.

MarCom South – Further investigation of the nature and extent of contamination in the bank was conducted in 2012. Contaminants are PAHs and metals (arsenic, cadmium, chromium, copper, zinc)~~, and PAHs~~.

RM 7

Willamette Cove - Riverbank contaminants are PCBs, dioxins/furans, metals (lead, mercury, nickel, and copper), and PAHs. Source control evaluation is currently ongoing.

Commented [CS285]: Another example of various methods used to describe metals.

Commented [KK286]: Accept edit.

RM 8.5

Swan Island Shipyard – Recent sampling results for OU1 indicate that contaminants include metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc), PAHs, PCBs, and tributyltin. Contaminants in river bank soils in ~~OU2/~~OU5 include metals (arsenic, ~~cadmium,~~ copper, lead, and zinc), PAHs, and PCBs~~, and tributyltin~~. Source control evaluation is currently ongoing. ~~Work at OU5 indicated metals (arsenic, copper, lead, and zinc), PAHs, and PCBs in river bank soils.~~

Commented [CS287]: Another example of various methods used to describe metals.

Commented [CS288]: Another example regarding various descriptions of metals as a group versus individually.

West Side of Willamette River

RM 4

Kinder Morgan Linnton Bulk Terminal – Contaminants are petroleum constituents (BTEXs and PAHs) and metals (arsenic and lead).

RM 6

NW Natural/Gasco – Contamination associated with historical MGP waste are known to be located in the river bank. Contaminants include PAHs, gasoline- range hydrocarbons, diesel- range hydrocarbons, residual-range hydrocarbons, cyanide, and metals (zinc).

RM 6 and RM 7

Siltronic – Contamination associated with historical MGP waste is known to be present in the northern portion of the Siltronic riverbank. Riverbank contaminants include PAHs, gasoline- range hydrocarbons, diesel- range hydrocarbons, residual-range hydrocarbon and cyanide and metals (zinc).

Burlington Northern and Santa Fe Railroad Bridge – Contamination associated with and pesticide and herbicide releases from Rhone Poulenc and Arkema are known to be present in the river bank below and adjacent to the Burlington Northern and Santa Fe railroad bridge. Riverbank contaminants include, dioxin/furans, metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc, Insecticides (DDD, DDE, DDT, aldrin, alpha-BHC, alpha-chlordane, beta-BHC, cis-nonachlor, delta-BHC, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, endrin ketone, gamma0BHC, gammachlordane heptachlor, heptachlor epoxide, hexachlorobutadiene, methoxychlor, mirex, oxychlordane, and trans-nonachlor), PCBs, SVOCs (acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzoic acid, benzyl alcohol, bis (2-ethylhexyl)phthalate, butylbenzylphthalate, chrysene, bibenzo(a,h)anthracene, dimethylphthalate, bi0n-butylphthalate, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene). (AMEC 2011)~~and pesticide and herbicide releases from Rhone Poulenc and Arkema are known to be located in the river bank. Contaminants include PAHs, gasoline- range hydrocarbons, diesel- range hydrocarbons, residual-range hydrocarbons, cyanide, metals, PCP, 2,4-DP, Bromoxynil, 2,4-DB, MCPA, MCPP, MCPB, 2,4-T, 2,4-D, DDT, Endrin, Heptachlor, sodium chlorate, sodium arsenate, 2,4,5-TP, 2,4,5-T, aldrin, dieldrin, and chlordanes~~.

RM 7
Arkema –Riverbank contaminants include DDT, dioxin/furans, PCBs, and metals (chromium and lead).

RM 9
Gunderson –Contaminants include metals (lead, nickel, and zinc), and PCBs.

1.2.4 Contaminant Fate and Transport

Most of the sediment contamination at the Site is associated with known or suspected historical sources and practices. Ongoing sources of contamination include contaminated groundwater plumes, river bank soils, stormwater and upstream surface water. The distribution contaminants in sediments in several nearshore areas appears to reflect more significant historical lateral inputs. ~~The spatial correlation between PCBs in aquatic organisms and sediments indicate that contamination in bottom sediments are an ongoing source of persistent bioaccumulative contaminants such as PCBs, DDx and dioxin/furans contamination to biota.~~As concluded in Section 10 of the RI, empirical tissue contaminant data and food web modeling indicate that persistent contaminants (particularly PCBs and dioxin/furans) in sediments and surface water bioaccumulate in aquatic species tissue.

Internal contaminant fate and transport processes are those processes that affect the fate, transport and redistribution of contaminants within the study area. The major internal fate and transport processes are:

- Erosion from the sediment bed

Commented [CS289]: The LWG cannot confirm the accuracy of this text without more specific information on how this text was developed. Once that information is available, the LWG will most likely have specific edits to this section.

Commented [KK290R289]: Information has been updated based on input from ODEQ. Reference provided.

Commented [CS291]: As another example, Appendix Q states “pesticides, furans and metals” for bank migration. Also, this is another example of various methods used to describe metals.

Commented [CS292]: This is an incomplete sentence. Not sure what the intended meaning is.

Commented [KK293R292]: Reject edit. Sentence has been modified.

Commented [CS294]: These biological data have not been discussed at all up to this point, and the draft FS information on contaminants in biota was deleted. This provides one example of how removing critical information from Section 2 of the draft FS has immediate impacts on the ability for even fundamental FS concepts to be clearly discussed and presented.

Commented [KK295R294]: Sentence has been modified with reference added.

Commented [CS296]: Because of the lack of discussion of chemicals in biota, this sentence becomes entirely unsupported and unclear.

Commented [KK297R296]: Discussion is provided in RI report.

Commented [CS298]: The concept of internal vs. external processes should be introduced before this to be clear. This information was included in draft FS Section 2.5.2, which EPA deleted.

Commented [KK299R298]: Comment addressed with definition of internal processes. The section that LWG references focuses primarily on internal and external sources rather than processes.

- Deposition to the sediment bed
- Dissolved flux from the sediment bed (porewater exchange)
- Groundwater advection
- Degradation (for some contaminants)
- Volatilization
- Downstream transport of either particulate-bound or dissolved phase contaminants

These processes interact to create complex patterns of contaminant redistribution that vary over space, time, and by contaminant. A discussion of fate and transport modeling for different classes of contaminants, which estimated the magnitude of various processes within the Study Area, is presented in the RI. In addition, empirical estimates of contaminant loading associated with internal and external contaminant sources were developed during the RI. External sources include upstream loading (via surface water and sediment bedload), "lateral" external loading such as stormwater runoff permitted discharges (point-source, non-stormwater), upland groundwater (contaminant plume transport to river), atmospheric deposition (to the river surface), direct upland soil and riverbank erosion, otherwise uncontaminated groundwater advection through contaminated subsurface sediments (chemical partitioning from subsurface sediment to pore water and advection to the surface sediment interval), and overwater releases. Internal sources include surface sediment loading to the surface water via sediment erosion (resuspension) and sediment porewater exchange (chemical partitioning from surface sediment to porewater and advection to surface water), as well as sinks. **Figures 1.2-20~~2~~a** through **1.2-20~~2~~c** provides a visual summary of currently known or suspected contaminant source loads within and exiting from the Site for three representative contaminants: total PCBs, benzo(a)pyrene, and DDE.

Elevated concentrations of contaminants in the Study Area are typically associated with areas near currently known or likely historical and/or existing sources. Although the highest sediment concentration are generally found in nearshore areas, elevated levels of contamination are also found in the higher energy portion of the channel in the middle of the Study Area (RM 5 to 7). This may reflect past or current dispersal of material away from nearshore source areas. Throughout the Study Area, contaminant concentrations are generally higher in subsurface sediments than in surface sediments, indicating both higher historical contaminant inputs and improving sediment quality over time. Localized exceptions to the pattern of higher subsurface sediment concentrations exist in a few areas for some contaminants, likely reflecting more recent

Commented [CS300]: Empirical loading estimates were presented in the RI. Modeling supporting development of the referenced figures was only conducted for and presented in the draft FS. It is unclear where and when this modeling is going to be discussed in the early sections of the FS, which it should be.

Commented [KK301R300]: Language added regarding internal and external sources which is important to the FS. Need to discuss further F&T model.

releases and/or disturbances of bedded sediments. Also, the depth of subsurface contamination is generally greater in nearshore areas as compared to the navigation channel.

Areas with elevated contaminant concentrations in surface sediments generally correspond to areas of elevated subsurface sediment contaminant concentrations, particularly in nearshore areas. Areas where only surface or subsurface sediments exhibited elevated concentrations of contaminants point to spatially and temporally variable inputs and sources, or to different influences from sediment transport mechanisms. Per the RI, the PCB distributions in areas of elevated PCB concentrations are generally distinct from those in surrounding areas of lower PCB concentrations. Within areas of elevated PCB concentrations, the PCB patterns in surface and subsurface sediment, sediment traps, and in the particulate portion of the surface water samples are often similar. A similar pattern and similar composition across media was observed to a lesser degree for PAHs, but was less apparent for dioxins/furans or DDx compounds.

Most areas of elevated contaminant concentration in bedded sediment are located in relatively stable nearshore areas, and large-scale downstream migration/dispersal of concentrated contaminants from these areas is not indicated by the bedded sediment data. Much larger historical direct discharges from upland and overwater sources, rather than reworking of bedded sediments, are believed to have produced some of the observed patterns (e.g., elevated levels in subsurface sediments downstream of the source areas). Limited ongoing downstream dispersal of contaminants in sediments is suggested based on bedded sediment concentration gradients downstream of areas with elevated sediment concentrations.

Patterns of contamination in bedded surface sediment suggest some redistribution of contaminants over time from past source areas, but this is limited by ~~re-~~burial of much of the source area contamination (as indicated by higher subsurface sediment concentrations in these areas). Periodic erosion may temporarily expose buried contamination.

Groundwater plume discharge to surface water~~advection and release~~ has been observed in several areas ~~along with d~~Dissolved phase flux from surface sediments to the water column has been inferred from RI data.

Based on results of surface water data collected during the RI, resuspension and/or dissolved phase flux from the sediment bed are contributing to contaminant concentrations in surface water, particularly in quiescent areas where surface water mixing and dilution is minimal. Loading estimates presented in **Figures 1.2-20~~2~~a** through **1.2-20~~2~~c** are consistent with this concept, indicating the mass flux of

Commented [KK302]: Accept edit.

Commented [CS303]: With most of the supporting information on sediment deposition and erosion patterns deleted, this text all appears as conjecture. This is another example where information supporting CSM discussions is needed.

Commented [KK304R303]: Information from Section 2.6.2 of the draft FS added to address the above comment with respect to contaminant distribution.

Commented [CS305]: Advection is a specific process that requires detailed measurements that were not conducted for the RI.

Commented [KK306R305]: Agreed.

Commented [CS307]: We are unaware of where this process has been directly measured or observed at the Site. We only know of the existence of this process through reference to standard sediment processes in the literature using inferences from indirect site data.

Commented [KK308R307]: Agreed.

Commented [KK309]: Accept edits.

contaminants exiting the downstream end of the Study Area in surface water (either directly to the Columbia River or via Multnomah Channel) is greater than the flux entering the Study Area. Contaminant concentrations in ~~loads~~ stormwater entering the Study Area ~~from adjacent upland sources and pathways (such as stormwater)~~ are generally greater than concentrations associated with upstream surface water. However, from a loading perspective, lateral contaminated loads associated with upland sources are comparable to upstream loads for key contaminants including ~~in the upstream loads (upriver surface water and sediments). Stormwater input is the most important current source pathway within the Study Area for many contaminants, including~~ PCBs and DDx.

Finally, empirical tissue contaminant data and food web modeling indicate that persistent contaminants (particularly PCBs and dioxin/furans) in sediments and surface water can bioaccumulate in aquatic species tissue.

The CSM integrates the information gathered to date to provide a coherent hypothesis of the Site fate and transport. **Figure 1.2-2~~13~~** provides a simplified~~general overall~~ visual summary of this hypothesis, including contaminant interactions with human and ecological receptors.

1.2.5 Baseline Risk Assessment

This section presents a summary of the results of the baseline human health and ecological risk assessments (BHHRA and BERA) ~~and BERA completed as part of the RI conducted under CERCLA~~. These assessments are ~~summarized in Sections 8 and 9, respectively, of the RI, and in their entirety in~~ presented in Appendices F and Appendix G of the RI report.

1.2.5.1 Baseline Human Health Risk Assessment

The BHHRA presents~~ed~~ an analysis of the potential for effects associated with both current and potential future human exposures at Portland Harbor ~~and followed an overall process based on EPA guidance and numerous agreements with EPA, DEQ, Oregon Health Authority (OHA, formerly the Department of Human Services), and Native American Tribes~~. Potential exposure to contaminants found in environmental media and biota was evaluated for various occupational and recreational uses of the river, as well as recreational, subsistence, and traditional and ceremonial tribal consumption of fish caught within the Portland Harbor site. Additionally, because of the persistent and bioaccumulative nature of many of the contaminants found in sediment, infant consumption of human breast milk was also quantitatively evaluated. ~~The specific populations and exposure pathways evaluated were:~~

~~Dockside workers — direct exposure via incidental ingestion and dermal contact with beach sediments.~~

Commented [CS310]: This is not correct for DDx. The mass loading evaluation in the RI shows that outside study area/upstream sources account for a much larger mass of DDx than is contributed from all of the study area.

For example, the last paragraph of page 10-18 of EPA's RI Section 10 states: "The most significant current influx of DDx to the Study Area is upstream surface water, and is associated with both the dissolved and suspended particulate fraction." Note that the wording "contaminant concentrations in loads" is incorrect. Concentrations and loads are distinct concepts that should not be conflated in this way. Because a loading figure is supporting this discussion, the text should stick to a discussion of loads, not concentrations.

Commented [KK311R310]: Agree. It is important to distinguish between concentration and load. For example, while contaminant concentrations in stormwater are many times higher than upstream, contaminant loads associated with upland sources are comparable to upstream loads. Paragraph has been revised accordingly.

Commented [KK312]: Accept edit.

Commented [KK313]: Accept edit.

Commented [CS314]: Per LWGs 7/23/14 major issues summary, although EPA retained some references to a few CSM fate and transport processes, the bulk of the Draft FS CSM description was removed. Critical CSM information for FS alternative development and evaluation that was removed includes, but is not limited to, the following: 1) physical factors and processes (e.g., descriptions of bathymetry, deposition/erosion, debris, substrate types, and shoreline conditions); 2) site uses (e.g., channel and maintenance dredging areas); 3) human activities (e.g., vessel traffic patterns, propwash, and historical remediation); 4) chemical distributions; 5) biological habitats and restoration sites; 6) site sources; and 7) potential risks. EPA's CSM focuses on a cartoon from the draft FS, which is insufficient to convey the existence and interplay of these various CSM factors (as compared to the detailed CSM maps in Draft FS Figure 2.6-2, which were deleted).

Commented [KK315R314]: EPA is presenting the relevant information necessary for the introduction to this document. Where additional information is necessary in developing and evaluating remedial options, those concepts and data will be presented. It is not necessary to completely re-present the RI in the FS report for the reader to have context of the site. EPA guidance does not require that a full CSM be described in the FS.

Commented [CS316]: EPA requested during FS discussions that LWG suggest additional text for the RA summary that provides better context for the risk assessment results. Several paragraphs were added to both the human health and ecological summaries per this request.

Commented [KK317R316]: EPA did not ask for the LWG to suggest additional text. EPA told the LWG that if they had any modifications they wanted made to the FS, the LWG was to provide text for us to consider. EPA does not agree with this added language as providing better context for the risk assessment results.

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~~In-water workers – direct exposures to in-water sediment.~~
~~Transients – direct exposure to beach sediment, surface water for bathing and drinking water scenarios, and groundwater seeps.~~
~~Recreational beach users – direct exposure to beach sediment and surface water while for swimming.~~
~~Tribal fishers – direct exposure to beach or in-water sediments, and consumption of migratory and resident fish.~~
~~Recreational and subsistence fishers – direct exposure to beach or in-water sediments, consumption of resident fish, and consumption of shellfish.~~
~~Divers – direct exposure to in-water sediment and surface water.~~
~~Domestic water user – direct exposure to untreated surface water potentially used as a drinking water source in the future.~~
~~Infant consumption of human breast milk – exposure to certain persistent and bioaccumulative contaminants (polychlorinated biphenyls [PCBs], dichlorodiphenyldichloroethane, dichlorodiphenyldichloroethylene, and dichlorodiphenyltrichloroethane [DDx] compounds, dioxins and furans, and polybrominated diphenyl ethers [PBDEs]) via nursing infants of dockside and in-water workers, divers, and recreational, subsistence, and tribal fishers.~~

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Consistent with EPA policy, the BHHRA evaluated a reasonable maximum exposure (RME), which is defined as the maximum exposure that is reasonably expected to occur. In addition, estimates of central tendency (CT), which are intended to represent average exposures, were also evaluated. **Figure 1.2-**2~~24~~ presents the conceptual site model for the BHHRA.

Commented [KK318]: Edited text OK.

~~Cancer risk and noncancer hazard from site-related contamination was characterized based on current and potential future uses at Portland Harbor, and a large number of different exposures scenarios were evaluated. Based on 2002 and 2007 fish tissue data, exposure to bioaccumulative contaminants (PCBs, dioxins/furans, and organochlorine pesticides, primarily DDx compounds) via consumption of resident fish consistently poses the greatest potential for human exposure to in-water contamination. Scenarios for which the cumulative estimated cancer risk is greater than 1 x 10^{-4} or the HI is greater than 1 are consumption of fish and shellfish, and direct contact with in-water sediment by tribal and high frequency fishers.~~ The major findings of the BHHRA are:

Commented [KK319]: This is redundant with first bullet.

- Estimated cancer risks resulting from the consumption of fish or shellfish are generally orders of magnitude higher than risk resulting from direct contact with sediment and surface water. Risks and noncancer hazards from fish and shellfish consumption exceed the EPA point of departure for cancer risk of 1 x 10^{-4} and target hazard index (HI) of 1 when evaluated on a harbor-wide basis, and when evaluated on the smaller spatial scale by river mile.

- Consumption of resident fish species consistently results in the greatest risk estimates. Evaluated harbor-wide wide, the estimated RME cancer risks are 4 x 10^{-3} and 1 x 10^{-2} for recreational and subsistence fishers, respectively.

- Evaluated on a river mile scale, it is only at RM 5 that ~~the~~ RME risk estimates from consumption of resident fish is less than 1 x 10^{-4}.

- Noncancer hazard estimates for consumption of resident fish species are greater than 1 at all river miles. Based on a harbor-wide evaluation of noncancer risk, the estimated RME HI is 300 and 1,000 for recreational and subsistence fisher, respectively. The highest hazard estimates for recreational fishers are at RM 4, RM 7, RM 11, and in Swan Island Lagoon.

  The highest noncancer hazards are associated with nursing infants of mothers, who consume resident fish from Portland Harbor. When fish consumption is evaluated on a harbor-wide basis, the estimated RME HI is 4,000 and 10,000 for breastfed infants of ~~breastfeeding~~ recreational and subsistence fishers, respectively. Evaluated on a harbor-wide scale, the estimated RME HI for tribal consumers of migratory and resident fish is 600 assuming fillet-only consumption, and 800 assuming whole-body consumption. ~~.~~ The corresponding HI estimates for nursing infants of ~~tribal~~ mothers, who consume fish, are 8,000 and 9,000 respectively, assuming maternal consumption of fillet or whole-body fish.

- PCBs are the primary contributor to risk from fish consumption harbor-wide. When evaluated on a river mile scale, dioxins/furans are a secondary contributor to the overall risk and hazard estimates, particularly ~~and pose the highest risk~~ at RM 6 and 7. PCBs are the primary contributors to the noncancer hazard to nursing infants, primarily because of the bioaccumulative properties of PCBs and the susceptibility of infants to the developmental effects associated with exposure to PCBs.

- The greatest source of uncertainty in the risk and hazard estimates includes the lack of good site-specific information about consumption of resident fish from Portland Harbor. Because tribal fish consumption practices were evaluated assuming a combined diet consisting of both resident and migratory fish, it is not clear to what degree contamination in Portland Harbor contributes to those estimated risks. In addition, it is important to remember that the noncancer hazard estimates presented in the BHHRA are not predictions of specific disease, and the cancer estimates represent upper-bound values, and the EPA is

Commented [KK320]: Disagree with edit. Text will remain. This is consistent with conclusions of BHHRA.

Commented [KK321]: Edit is OK.

Commented [KK322]: The fishers are not breastfeeding the infants are.

Commented [KK323]: Text is not necessary. Sentence begins with The corresponding…which means that it links with previous sentence that discusses tribal fisher.

Commented [CS324]: Although this language is directly from the BHHRA it lacks some of the wider context from that document. The LWG is working on additional language here to summarize the wider context available from the BHHRA. The LWG will suggest specific language by August 29.

Commented [KK325R324]: EPA does not believe that additional context is necessary.

Commented [KK326]: The edits proposed are inconsistent with the findings of the BHHRA.

Commented [KK327]: Disagree with edit.

reasonably confident that the actual cancer risks will not exceed the estimated risks presented in the BHHRA.

1.2.5.2 Baseline Ecological Risk Assessment

The BERA presents an evaluation of risks to aquatic and aquatic-dependent species within the Study Area in the absence of any actions to control or mitigate contaminant releases. The overall process used for the BERA was based on the guidance provided in the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments – Interim Final* (EPA 1997c) and followed the approach documented in numerous interim deliverables as well as discussions, directives, and agreements with the LWG, EPA and its federal, state, and tribal partners. **Figure 1.2-23~~5~~** presents the conceptual ~~se~~ite model for the BERA.

Commented [KK328]: Accept edit.

~~Sediment toxicity tests were performed to evaluate adverse effects of Portland Harbor sediment on survival and biomass of larvae of the aquatic insect *Chironomus dilutus* and juveniles of the amphipod *Hyalella azteca*. These toxicity tests demonstrated that the exposure of these animals to sediment from some locations within Portland Harbor resulted in increased mortality and/or reduced biomass of these two species within 10 to 28 days – a direct measure of sediment toxicity to benthic invertebrates within the Portland Harbor Study Area. The moderate and severe levels of toxicity were not randomly scattered throughout the Study Area. Instead, most samples and locations eliciting multiple instances of moderate and severe toxicity tended to be clustered in several areas, especially areas between RM 5.9 and RM 7.8. Other areas with "clusters" of benthic toxicity included International Slip; between RMs 3.7 and 4.2 on the west side of river; between RMs 4.8 and 5.2 on the west side of river; Willamette Cove; near the mouth of Swan Island Lagoon; and between RMs 8.7 and 8.8 on the west side of river. A weight-of-evidence analysis identified 17 benthic areas of concern (AOCs) within the Study Area. Combined, the above areas can be estimated to cover between 4 and 8% of the total surface area of sediment within the Study Area.~~

Commented [KK329]: Reject edit.

~~Aside from the toxicity testing used to characterize risks to the benthic community, most risk characterizations in the BERA were made using the hazard quotient (HQ). An HQ is calculated by dividing the exposure estimate by a effects threshold. COPCs for which the HQ was ≥ 1.0 were identified as contaminants posing potentially unacceptable risk at the conclusion of the BERA. The potential for unacceptable risk becomes increasingly large as the HQ value increases, although the increase is not necessarily linear (e.g., a sample with an HQ = 2.0 does not necessarily have twice the risk of a sample with an HQ = 1.0).~~

~~In ERAs, the ecological significance of the identified risks is determined by evaluating if the risks will make an observable difference in light of other factors that are influencing the environment, such as habitat alteration.~~

~~With the exception of species protected by law or regulation (e.g., threatened and endangered species) for which individual organisms are protected, EPA guidance and policy state that ERAs should generally focus on the protection of local populations and communities of biota (e.g., the Study Area population of smallmouth bass, not the global population of smallmouth bass, which exists on four continents). Oregon's ERA guidance (ODEQ 1998) defines a local population for a stream or river as follows, "For aquatic species in moving water such as streams and rivers (lotic habitats), the local population comprises all individuals of the endpoint species within the stream segment within the contaminated area."~~

~~Ecological significance can be defined as the importance of an adverse effect on population, community, or ecosystem responses. Factors contributing to ecological significance considered in the BERA included the nature and magnitude of effects, the spatial and temporal extent of effects, uncertainties in the exposure assessment, uncertainties in the effects characterization, and concordance of the various LOEs used to assess risk to communities or populations.~~

~~The LWG and EPA separately evaluated the ecological significance of the identified risks and drew independent conclusions. Both parties found that PCBs, PAHs, dioxins and furans, and total DDx are ecologically significant contaminants at Portland Harbor. EPA identified several additional contaminants that it considers most likely to be ecologically significant contaminants~~

The following presents the primary conclusions of the BERA.

- In total, 93 contaminants (as individual contaminants, sums, or totals)[3] with HQ ≥ 1.0 pose potentially unacceptable ecological risk. Differences in the specific toxicity reference values (TRVs) used in different lines of evidence (LOEs) for total PCBs (e.g., total PCBs versus specific Aroclor mixtures), total DDx, and total PAHs, all of which describe individual contaminants or a group of multiple but related individual chemical compounds, can result in different counts of the number of contaminants posing potentially unacceptable risk. The list of contaminants posing potentially unacceptable risks can be condensed if individual PCB, DDx and PAH compounds or groups are condensed into three comprehensive groups: total PCBs, total DDx, and total PAHs. Doing so

[3] The five chemicals or chemical groups with concentrations that exceeded only the sediment probable effects concentration (PEC) and/or probable effects level (PEL) (i.e., chemicals that were not identified as COPCs for other benthic invertebrate LOEs: Aroclor 1254, chlordane [cis and trans], gamma- hexachlorocyclohexane [HCH] [Lindane], heptachlor epoxide, and total chlordane), ammonia and sulfide (which are conventional parameters), and residual-range hydrocarbons that had concentrations that exceeded only the total petroleum hydrocarbons [TPH] SQGs) are not included in this count.

reduces the number of contaminants with HQ ≥ 1.0 posing potentially unacceptable risks to 66.

- Risks to benthic invertebrates are clustered in 17 benthic AOCs.

- Sediment and TZW samples with the highest HQs for many contaminants also tend to be clustered in areas with the greatest benthic invertebrate toxicity.

- The COPCs in sediment that are most commonly spatially associated with locations of potentially unacceptable risk to the benthic community or populations are PAHs and DDx compounds.

- Not all COPCs posing potentially unacceptable risk have equal ecological significance. The most ecologically significant COPCs (i.e., contaminants of primary ecological significance) are PCBs, PAHs, dioxins and furans (as TEQ), and DDT and its metabolites.

Commented [KK330]: Accept edits.

- The list of ecologically significant COPCs is not intended to suggest that other contaminants in the Study Area do not also present potentially unacceptable risk.

- The contaminants identified as posing potentially unacceptable risk in the largest numbers of LOEs are (in decreasing frequency of occurrence) total PCBs, copper, total DDx, lead, tributyltin (TBT), zinc, total toxic equivalent (TEQ), PCB TEQ, benzo(a)pyrene, cadmium, 4,4′-DDT, dioxin/furan TEQ, bis(2-ethylhexyl) phthalate, naphthalene, and benzo(a)anthracene. The remaining 78 contaminants posing potentially unacceptable risk were identified as posing potentially unacceptable risk by three or fewer LOEs.

- Of the three groups of contaminants (i.e., total PAHs, total PCBs, total DDx) with the greatest areal extent of HQs ≥ 1.0 in the Study Area, PAH and DDx risks are largely limited to benthic invertebrates and other sediment-associated receptors. PCBs tend to pose their largest ecological risks to mammals and birds.

- The combined toxicity of dioxins/furans and dioxin-like PCBs, expressed as total TEQ, poses the potential risk of reduced reproductive success in mink, river otter, spotted sandpiper, bald eagle, and osprey. The PCB TEQ fraction of the total TEQ is responsible for the majority of total TEQ exposure, but the total dioxin/furan TEQ fraction also exceeds its TRV in some locations of the Study Area.

1.3 FS DATABASE DESCRIPTION

~~As discussed in detail in the RI, environmental data have been collected within the Portland Harbor Site during numerous LWG sampling events and from other historical and concurrent studies and constitute the Portland Harbor Site Characterization and Risk Assessment (SCRA) database. Additional data were added to the SCRA database and used for the draft FS database including data collected through March 2010. For the revised FS, EPA added surface and subsurface sediment data collected at the Gasco Sediments and Arkema early action sites after March 2010 and up to ____[LWG is currently reviewing EPA's most recent database and can insert specific dates here once this review is complete.]. As noted above, newer data from the Rivermile 11E RI/FS activities were not included in the FS database. Data for all other media in the revised FS database are the same as those in the draft FS database. Tissue data are not included in the FS database.~~

~~For the RI and FS a date of May 1, 1997 was used to define the initiation of the sediment dataset to follow the last major flood of the Willamette River in the winter of 1996. Data evaluation, selection, totaling, and other rules and procedures for the draft FS are described in more detail in Appendix R. The RI database or the draft FS database may be used for some depictions or evaluations in this FS and these instances are noted in the text when they occur. For example, figures X,Y,Z from Section 1 are taken from the RI and use the RI database. Unless otherwise noted the revised FS database was used in FS evaluations.~~

Commented [CS331]: EPA requested that LWG suggest a subsection describing the FS database.

Commented [KK332R331]: Agreed because the LWG argued that a discussion should be included. Reject edits. This discussion needs to describe the data that is in the database. This discussion does not provide this information. Need further discussion.

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Commented [CS333]: If after completing our review of EPA's database it appears that some but not all of the available data from Arkema and Gasco have been included, those specifics will also need to be added here.

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Commented [CS334]: We think an updated version of Appendix R would be useful for the revised FS, or EPA could simply refer to the draft FS Appendix R here.

Commented [CS335]: These figure numbers will need to be specified once Section 1 figures are finalized.

Commented [CS336]: Given that EPA is including figures from the RI in Section 1, which are not consistent with the revised FS database, some statement like this will be needed in the revised FS. If this text is not consistent with EPA's intent, EPA should edit it to be consistent with the procedures EPA intends to use.

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